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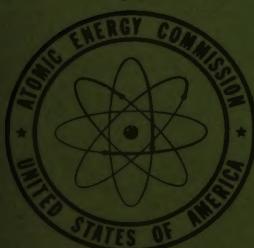
# Nuclear Science Abstracts

QUARTERLY CUMULATIVE INDEX

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Technical Information Service, Oak Ridge, Tennessee

## GUIDE TO ABSTRACT WRITING

1. *Purpose.* It is very important that a paper be accompanied by an abstract, preferably appearing at the beginning. This abstract is not part of the paper—it is an adjunct intended to convey briefly the content of the paper, to draw attention to all new information and to the main conclusions. It should be directly informative, not merely indicative.

2. *Style of Writing.* The abstract should be written concisely and in normal rather than abbreviated English. Where possible, standard terms should be used and unnecessary contracting should be avoided. The third person is preferable. Mixed tenses, and both indicative and imperative forms should be avoided.

It should be presumed that the reader has some knowledge of the subject, but has not read the paper. He may not even have the paper available at all, if he is working with the abstract journal only. The abstract should, therefore, be intelligible in itself, without reference to the paper; for example, it should not cite sections or illustrations as a substitute for a statement of their content.

3. *Content.* The title of the paper is usually read as part of the abstract, therefore repetition of the title in the opening sentence of the abstract should be avoided. If the title is insufficiently comprehensive to indicate the subjects covered or the objects of the investigation, the opening sentence should make this clear.

The abstract should state newly observed facts, conclusions of an experiment or argument and, if possible, the essential parts of any new theory, treatment, apparatus, technique, etc.

It should contain the names of any new compound, and any new numerical data, such as physical constants; if this is not possible it should draw attention to them. It is important to refer to new items and observations, even though they may be incidental to the main purpose of the paper.

When giving experimental results, the abstract should indicate the methods used; for new methods, the basic principle, range of operation, and degree of accuracy should be given.

4. *Detail of Layout.* It is impossible to recommend a standard length for an abstract. It should, however, be concise and should not normally exceed 200 words. References should be omitted from the abstract whenever possible.

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A Publication of the United States Atomic Energy Commission, Technical Information Service

The printing of this publication has been approved by  
The Director of the Bureau of the Budget, August 2, 1951.

Nuclear Science Abstracts is issued twice monthly throughout the calendar year by the Atomic Energy Commission. It is intended primarily to serve scientists and engineers working within the Atomic Energy Project by abstracting as completely and as promptly as possible the literature of nuclear science and engineering. It covers not only the unclassified and declassified research reports of the Atomic Energy Commission and its contractors, but also material in its field of interest which appears in technical and scientific journals and unpublished research reports of government agencies, universities, and industrial research establishments.

### DECLASSIFICATION

Issuing of these Abstracts does not constitute authority for declassification of any reports.

### INDEXES

Nuclear Science Abstracts is fully indexed by author, subject, and report number. Annual index issues are prepared for each volume, and the next cumulated index will appear in volume 10(1956) covering volumes 5-10. A cumulated index to volumes 1-4 was issued as volume 4, No. 24B, Dec. 30, 1950 covering authors, subjects, nuclides, and report numbers. The 24th number of volumes 5 and 6 contain indexes covering the individual volumes and a completely cumulated Numerical Index of Reports.

Each issue of volume 7(1953) contains an author index to abstracts in that issue and a supplement to the Numerical Index of Reports. Subject and author indexes, as well as a cumulation of the Numerical Index of Reports, covering three-month periods are issued as supplements to the sixth, twelfth, and eighteenth issues. The 24th issue will be the annual index for the year, superseding the three index supplements mentioned above.

### AVAILABILITY

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# NUMERICAL INDEX OF REPORTS

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3469	7-530	J. Phys. Chem. 57, 541-4(1953)	2346	7-1829	Phil. Mag. (7) 44, 449-50(1953)
3478	7-794	J. Am. Chem. Soc. 75, 3019-20(1953)	2349	7-1647	Anal. Chem. 25, 950-3(1953)
3485	7-1415	Iron Age 171, No. 5, 110-13(1953)	2353	7-1815	Phys. Rev. 90, 899-911(1953)
3499	7-1611	\$0.25	2362	7-1573	Genetics 38, 272-307(1953)
	7-1986	0.10	2364	7-1606	J. Am. Chem. Soc. 75, 3063-8(1953)
AECU			2371	7-1576	J. Bacteriol. 65, 739-43(1953)
1790	6-805	J. Am. Chem. Soc. 75, 2269-70(1953)	2379	7-2601	Nucleonics 11, No. 5, 60-1(1953)
1820	6-1083	Am. J. Roentgenol. Radium Therapy 69, 1001-4(1953)	2388	7-1858	Cancer Research 13, 86-92(1953)
1859	6-1708	Ind. Eng. Chem. 44, 1371-8(1952)	2389	7-1860	Lab. Invest. 2, 91-108(1953)
1865	6-1694	J. Chem. Phys. 21, 490-1(1953)	2393	7-1861	Cancer Research 13, 80-5(1953)
1893	6-2385	J. Phys. Chem. 57, 336-41(1953)	2396	7-2117	J. Gen. Physiol. 36, 659-71(1953)
1944	6-2885	Plant Physiol. 28, 89-98(1953)	2406	7-2051	Phys. Rev. 90, 603-6(1953)
2051	6-4121	Rev. Sci. Instr. 23, 764(1952)	2408	7-2182	Nucleonics 11, No. 5, 62-4(1953)
2066	6-4381	J. Infectious Diseases 92, 288-300(1953)	2409	7-1956	Phys. Rev. 90, 862-4(1953)
2080	6-4439	Anal. Chem. 25, 438-46(1953)	2412	7-1912	J. Am. Chem. Soc. 75, 2830-2(1953)
2108	6-4718	J. Biol. Chem. 200, 31-7(1953)	2430	7-2484	J. Am. Chem. Soc. 75, 2212-15(1953)
2112	6-4726	J. Am. Chem. Soc. 75, 2869-72(1953)	2433	7-2575	Contribs. Boyce Thompson Inst. 17, 151-71(1953)
2162	6-5531	J. Biol. Chem. 200, 1-6(1953)	2434	7-2654	J. Am. Chem. Soc. 75, 3093-6(1953)
2188	6-5561	J. Am. Chem. Soc. 75, 3145-8(1953)	2435	7-2599	Phys. Rev. 91, 68-74(1953)
2197	6-5734	Rev. Sci. Instr. 24, 306-7(1953)	2436	7-2602	J. Chem. Phys. 21, 1087-92(1953)
2202	6-5714	NSA	2437	7-2993	Phys. Rev. 90, 493-4(1953)
2236	6-6290	Am. J. Pathol. 29, 305-21(1953)	2442	7-2876	Phys. Rev. 90, 845-8(1953)
2237	6-6439	NSA	2446	7-2895	Phys. Rev. 91, 125-9(1953)
2263	6-6528	Science 117, 534-5(1953)	2448	7-2851	Phys. Rev. 90, 839-43(1953)
2268	6-6648	J. Am. Chem. Soc. 75, 3096-8(1953)	2449	7-2877	J. Appl. Phys. 24, 811-12(1953)
2280	7-1	Am. J. Pathol. 29, 217-31(1953)	2457	7-3338	Phys. Rev. 90, 1063-5(1953)
2283	7-150	Acta Met. 1, 185-92(1953)	2471	7-2950	Am. J. Physiol. 169, 568-75(1953)
			2475	7-2754	Nature 171, 934-5(1953)
			2478	7-2756	J. Am. Chem. Soc. 75, 3089-92(1953)
					J. Chem. Phys. 21, 207-73(1953)

Report	Abstract	Availability	Report	Abstract	Availability
AECU	NSA		CEA	NSA	
2481	7-3218	Phys. Rev. 90, 1049-53(1953)	45	4-4694	Compt. rend. 230, 638-40(1950)
2489	7-2952	NSA	48	4-4373	Compt. rend. 230, 1866-7(1950)
2497	7-2942	J. Biol. Chem. 202, 323-30(1953)	49	4-4578	Compt. rend. 230, 1864-5(1950)
2498	7-2955	Proc. Soc. Exptl. Biol. Med. 83, 163-6 (1953)	50	4-5167	Helv. Physiol. et Pharmacol. Acta 8, 52-73(1950)
2515	7-2981	Lab. Invest. 2, 264-7(1953)	53	4-5264	J. phys. radium 11, 271-2(1950)
2519	7-3299	J. Biol. Chem. 202, 311-21(1953)	54	4-6070	Helv. Physiol. et Pharmacol. Acta 8, 146-68(1950)
2526	7-3553	NSA; Phys. Rev. 90, 721(1953)	55	5-2235	Compt. rend. 231, 345-7(1950)
2542	7-4245	Phys. Rev. 90, 714-15(1953)	57	5-2123	J. chim. phys. 47, Nos. 7-8(1950)
2543	7-4033	Proc. Soc. Exptl. Biol. Med. 83, 287-8 (1953)	59	5-188	J. phys. radium 11, 501-6(1950)
2553	7-4003	Proc. Soc. Exptl. Biol. Med. 83, 85-8 (1953)	61	5-3022	Industrie nati. No. 2, 51-60(1950)
2567	7-4247	Nucleonics 11, No. 7, 8-11(1953)	63	5-1317	J. phys. radium 11, 1E-2E(1950)
2568	7-4437	Phys. Rev. 90, 1119(1953)	75	5-5571	J. chim. phys. 48, 55-8(1951)
			76	5-6200	Bull. soc. chim. France (5) 18, 139(1951)
			77	5-6218	Bull. soc. chim. France (5) 18, 140-2 (1951)
AERE-C/R					
709	5-4730	J. Chem. Soc. 2889-92(1951)	81	5-6481	Compt. rend. 232, 2089-91(1951)
813	6-3771	Analyst 77, 859-66(1952)	82	5-6912	Compt. rend. 232, 2091-3(1951)
AERE-M/R					
740	6-226	Acta Met. 1, 49-70(1953)	90	5-6911	Compt. rend. 232, 2093-5(1951)
1014	7-1451	Acta Met. 1, 340-7(1953)	92	5-6848	J. phys. radium 12, 569-70(1951)
1015	7-1452	Acta Met. 1, 348-54(1953)	94	5-6428	J. phys. radium 12, 584-9(1951)
			97	5-6429	J. phys. radium 12, 573-9(1951)
BMI					
709(rev.)	6-898	J. Electrochem. Soc. 100, 103-6(1953)	100	5-6314	Compt. rend. 233, 426-8(1951)
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1019	6-507	Am. J. Physiol. 168, 626-7(1952)	101	5-6843	J. phys. radium 12, 697-9(1951)
1140	6-3107	Rev. Sci. Instr. 23, 671-77(1952)	102	5-6180	Bull. soc. chim. France (5) 18, 580-3 (1951)
1220	6-6118	Rev. Sci. Instr. 24, 437-44(1953)	103	5-6430	J. phys. radium 12, 751-5(1951)
1221	6-5964	Proc. Natl. Acad. Sci. U.S. 39, 403-7 (1953)	104	6-291	J. chim. phys. 48, 333-5(1951)
1228	6-5936	Am. J. Botany 40, 317-32(1953)	105	6-635	Compt. rend. 233, 785-7(1951)
1237	6-5939	J. Exptl. Zool. 122, 541-75(1953)	106	6-1622	Compt. rend. soc. biol. 145, 677-80(1951)
1238	6-5969	J. Cellular Comp. Physiol. 41, 207-24 (1953)	107	6-1847	Physica 17, 209-12(1951)
1239	6-5970	Am. J. Physiol. 171, 659-67(1952)	108	6-696	J. phys. radium 12, 17A-25A(1951)
1276	7-543	J. Am. Chem. Soc. 75, 2908-10(1953)	109	6-666	J. phys. radium 12, 32A-6A(1951)
1281	7-522	Science 117, 3050, 655-6(1953)	110	6-1787	J. phys. radium 12, 37A-40A(1951)
1282	7-555	J. Am. Chem. Soc. 75, 2215-17(1953)	111	6-634	J. phys. radium 12, 53A-64A(1951)
1306	7-1493	J. Chem. Phys. 21, 898-902(1953)	112	6-587	J. phys. radium 12, 64A-5A(1951)
1318	7-1453	J. Chem. Phys. 21, 890-1(1953)	113	6-1725	J. phys. radium 12, 66A(1951)
1326	7-1367	J. Clin. Invest. 32, 483-9(1953)	114	6-632	J. phys. radium 12, 67A-74A(1951)
1334	7-1650	J. Am. Chem. Soc. 75, 2832-6(1953)	115	6-1789	J. phys. radium 12, 74A-8A(1951)
1335	7-1651	J. Am. Chem. Soc. 75, 2837-40(1953)	116	6-1786	J. phys. radium 12, 78A-80A(1951)
1336	7-1972	J. Appl. Phys. 24, 779-82(1953)	117	6-1788	J. phys. radium 12, 777-83(1951)
1340	7-1989	J. Appl. Phys. 24, 668-74(1953)	118	6-697	J. phys. radium 12, 784-8(1951)
1353	7-2120	Phys. Rev. 90, 610-14(1953)	119	6-1623	J. physiol. (Paris) 43, 263-79(1951)
1354	7-2121	Phys. Rev. 91, 53-7(1953)	120	6-636	Compt. rend. 233, 1092-4(1951)
1355	7-2387	Phys. Rev. 90, 1013-18(1953)	121	6-1225	J. phys. radium 12, 854-9(1951)
1356	7-2643	Phys. Rev. 90, 587-602(1953)	122	6-845	J. chim. phys. 48, 412-14(1951)
1359	7-4455	Nucleonics 11, No. 6, 46-8(1953)	123	6-1225	Compt. rend. 233, 1369-71(1951)
1362	7-3511	Phys. Rev. 90, 868-9(1953)	124	6-1300	J. phys. radium 12, 952-3(1951)
1366	7-4076	J. Chem. Phys. 21, 943(1953)	125	6-1345	J. phys. radium 12, 955-6(1951)
1377	7-3923	Phys. Rev. 90, 497-8(1953)	126	6-2078	Compt. rend. 234, 538-9(1952)
1384	7-3826	Phys. Rev. 90, 324-5(1953)	127	6-4873	Nuovo cimento (9) 9, 169-83(1952)
1393	7-4275	Phys. Rev. 91, 78-81(1953)	128	6-4860	J. chim. phys. 48, 60-3(1952)
1430	7-4665	Phys. Rev. 90, 1126-7(1953)	129	6-4221	J. phys. radium 13, 10A-13A(1952)
CEA					
9	2-628	Compt. rend. 227, 829-31(1948)	130	6-4980	J. chim. phys. 48, 204-12(1952)
10	2-217	J. phys. radium 9, 256-8(1948)	131	6-3773	Bull. soc. chim. France (5) 19, 351(1952)
13	3-433	Compt. rend. 228, 480-1(1949)	132	6-3632	J. radiol. electrol. 33, 43-5(1952)
14	3-1543	Compt. rend. 228, 1224-6(1949)	133	6-3966	Compt. rend. 234, 1974-6(1952)
15	3-140 plus	J. phys. radium 10, 14D-16D, 17D-27D (1949)	134	6-4155	Compt. rend. 234, 1969-71(1952)
16	4-236	J. phys. radium 9, 143-6(1948)	135	6-5077	Bull. soc. chim. France (5) 19, 486-7 (1952)
20	2-831	J. phys. radium 9, 249-52(1948)	136	6-4922	J. phys. radium 13, 299-307(1952)
37	3-2184	Compt. rend. 229, 356-8(1949)	137	6-4956	Compt. rend. 234, 2355-7(1952)
38	4-294	Anal. Chim. Acta 7, 37-41(1952)	138	6-4917	Compt. rend. 234, 2448-50(1952)
	4-128	Bull. soc. chim. France (5) 16, D265-71 (1949)	139	6-5706	Compt. rend. 235, 38-40(1952)
	4-236	Compt. rend. 229, 447-9(1949)	140	6-5885	Compt. rend. 235, 159-61(1952)
	4-2317	J. phys. radium 11, 20(1950)	141	6-5319	Anal. Chim. Acta 7, 37-41(1952)
	5-2199	Compt. rend. 230, 79-81(1950)	142		
	4-5025	Helv. Phys. Acta 23, 70-3(1950)	143		
	3-2057	Compt. rend. 229, 447-9(1949)	144		
	4-2317	J. phys. radium 11, 20(1950)	145		
	5-2199	Compt. rend. 230, 79-81(1950)	146		
	4-5025	Helv. Phys. Acta 23, 70-3(1950)	147		
COO			103	7-3137	\$0.20
CRR			495	6-6596	1.00
ISC			154	6-735	Iowa State Coll. J. Sci. 27, 129-30(1953)
			183	6-2464	Iowa State Coll. J. Sci. 27, 231-2(1953)
			227	7-687	Phys. Rev. 90, 581-4(1953)

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ISC	NSA		NYO	NSA	
252	7-1527	<u>Phys. Rev.</u> <u>90</u> , 557-63(1953)	3369	6-1993	<u>J. Am. Chem. Soc.</u> <u>75</u> , 2736-8(1953)
262	6-5758	<u>Chem. Eng. Progr.</u> <u>49</u> , 243-52(1953)	3370	6-1994	<u>J. Am. Chem. Soc.</u> <u>75</u> , 2739-41(1953)
270	7-789	<u>J. Chem. Phys.</u> <u>21</u> , 986-92(1953)	3378	6-5062	<u>J. Chem. Education</u> <u>30</u> , 115(1953)
272	6-6549	<u>Acta Cryst.</u> <u>6</u> , 487-95(1953)	3380	6-5985	<u>J. Am. Chem. Soc.</u> <u>75</u> , 626-8(1953)
288	7-3755	\$0.25	3516	7-3000	<u>J. Am. Chem. Soc.</u> <u>75</u> , 2768(1953)
296	7-3007	<u>Anal. Chem.</u> <u>25</u> , 992-4(1953)	3554	6-4753	<u>Anal. Chem.</u> <u>25</u> , 784-7(1953)
306	7-3866	<u>Phys. Rev.</u> <u>91</u> , 28-30(1953)	3558	7-4043	<u>J. Am. Chem. Soc.</u> <u>75</u> , 3165-8(1953)
317	7-3793	<u>Phys. Rev.</u> <u>91</u> , 8-9(1953)	3611	6-6541	<u>Anal. Chem.</u> <u>25</u> , 784-7(1953)
326	7-3034	<u>J. Am. Chem. Soc.</u> <u>75</u> , 2272-3(1953)	3620	7-3893	<u>Phys. Rev.</u> <u>90</u> , 495-6(1953)
332	7-3040	<u>J. Am. Chem. Soc.</u> <u>75</u> , 2529-30(1953)	3643	7-2552	\$0.80
K			3654	7-3235	<u>Phys. Rev.</u> <u>90</u> , 712-13(1953)
			3673	7-4044	<u>Mining Eng.</u> <u>5</u> , 418(1953)
934	6-5731	<u>Rev. Sci. Instr.</u> <u>24</u> , 431-2(1953)	3876	7-575	<u>Eng. Mining J.</u> <u>153</u> , 95-9, 174, 176(1952)
968	7-533	<u>J. Phys. Chem.</u> <u>57</u> , 600-4(1953)	3710	7-3173	<u>NSA; Phys. Rev.</u> <u>90</u> , 724(1953)
KAPL			3712	7-2377	<u>Phys. Rev.</u> <u>90</u> , 959-87(1953)
832	7-1508	<u>Nucleonics</u> <u>11</u> , No. 5, 38-41(1953)	3713	7-2087	<u>Phys. Rev.</u> <u>90</u> , 951-9(1953)
LA			3879	7-4494	<u>Phys. Rev.</u> <u>91</u> , 194(1953)
1438	6-5345	<u>J. Am. Chem. Soc.</u> <u>75</u> , 2222-7(1953)	3872	7-2762	<u>J. Am. Chem. Soc.</u> <u>75</u> , 1769-70(1953)
LADC			3999	7-4503	<u>Phys. Rev.</u> <u>90</u> , 1004-5(1953)
1356	7-3840	<u>Phys. Rev.</u> <u>90</u> , 492-3(1953)	4517	7-3061	\$0.45
LT			4519	7-2738	0.25; <u>Nucleonics</u> <u>11</u> , No. 7, 60(1953)
			4521	7-2898	0.10
MR			ORNL		
17	6-6596	\$1.00	90	4-88	<u>Anal. Chem.</u> <u>21</u> , 1239-41(1949)
MTA			884	5-1127	<u>Proc. Phys. Soc. (London)</u> <u>66A</u> , 590-6(1953)
13	7-3586	<u>Phys. Rev.</u> <u>91</u> , 342-4(1953)	914	6-4482	\$0.25
14	7-3074	\$0.45	1142	6-3875	0.15
NAA-SR			1313	7-3041	0.35
212	7-2395	<u>Phys. Rev.</u> <u>90</u> , 1054-7(1953)	1324	6-5231	0.20
224	7-3008	<u>Nucleonics</u> <u>11</u> , No. 7, 53-6(1953)	1340	6-5655	0.20
NP			1411	7-2239	0.80
1884	5-987	<u>Can. Chem. Process Inds.</u> <u>35</u> , 397-8, 400-6(1951)	1459	7-2422	2.25
3057	5-3695	<u>J. Am. Chem. Soc.</u> <u>73</u> , 4727-9(1951)	1479	7-3159	0.35
3794	6-4120	<u>Anal. Chem.</u> <u>25</u> , 541-9(1953)	1525	7-3501	0.10
3817	6-4019	<u>J. Phys. Chem.</u> <u>57</u> , 149-52(1953)	1538	7-3720	0.20
3935	6-4642	<u>Arkiv Fysik</u> <u>6</u> , 57-68(1953)	ORO		
3999	6-5567	<u>J. Am. Chem. Soc.</u> <u>75</u> , 2467-70(1953)	82	7-535	<u>J. Chem. Phys.</u> <u>21</u> , 1060-69(1953)
4105	6-6304	<u>Can. J. Phys.</u> <u>31</u> , 613-28(1953)	85	7-1602	<u>Phytopathology</u> <u>43</u> , 236-8(1953)
4223	7-812	<u>Rev. Sci. Instr.</u> <u>24</u> , 371-4(1953)	91	7-2943	\$0.35
4361	7-1995	<u>Welding J.</u> <u>32</u> , 283-s-91-s(1953)	SO		
4421	7-2586	<u>Anal. Chem.</u> <u>25</u> , 718-21(1953)	3252	7-2847	\$0.25
4504	7-3117	<u>Phys. Rev.</u> <u>90</u> , 716-17(1953)	SUI		
4584	7-887	<u>Nucleonics</u> <u>10</u> , No. 11, 72-4(1952)	53-1	7-1701	<u>Nuovo cimento (9)</u> <u>10</u> , 630-47(1953)
NRC			TID		
2611	6-5790	\$0.20	3010(Suppl. 1)	7-2819	\$0.20
NSF-tr-			3036	7-3148	0.60
2	7-4695	\$0.10	5118	7-4242	0.60
3	7-4599	0.10	UCLA		
4	7-4696	0.10	47	4-1825	<u>J. Biol. Chem.</u> <u>185</u> , 519-24(1950)
5	7-4697	0.10	218	6-5009	<u>Nature</u> <u>171</u> , 487(1953)
9	7-4600	0.10	223	6-5931	<u>Proc. Soc. Exptl. Biol. Med.</u> <u>82</u> , 665-8(1953)
11	7-4646	0.10	227	6-6650	<u>Rev. Sci. Instr.</u> <u>24</u> , 459-60(1953)
			229	7-51	<u>Arch. Ind. Hyg. and Occupational Med.</u> <u>7</u> , 217-20(1953)
			235	7-1034	<u>Arch. intern. pharmacodynamie</u> <u>93</u> , 341-53(1953)
			236	7-737	<u>J. Am. Pharm. Assoc. Sci. Ed.</u> <u>42</u> , 296-300(1953)
			247	7-2489	\$0.35
NYO			UCRL		
1577	6-6414	\$0.55	1635	6-2987	<u>Nucleonics</u> <u>10</u> , No. 4, 14-17 and No. 5, 14-19(1952)
3024	7-2922	<u>Phys. Rev.</u> <u>90</u> , 606-8(1953)	1753	7-2612	<u>Rev. Sci. Instr.</u> <u>24</u> , 552-3(1953)
3068	7-3010	<u>Anal. Chem.</u> <u>24</u> , 1985(1952)	1809	6-4562	<u>Rev. Sci. Instr.</u> <u>24</u> , 462-3(1953)
3071	6-3351	\$0.60	1863	7-1631	<u>J. Am. Chem. Soc.</u> <u>75</u> , 2459-64(1953)
3144	7-2551	0.60	1898	6-6577	<u>J. Am. Chem. Soc.</u> <u>75</u> , 1859-63(1953)
3164	7-4041	NSA	1930	6-900	<u>Rev. Sci. Instr.</u> <u>24</u> , 388-90(1953)
3221	6-5913	<u>Phys. Rev.</u> <u>90</u> , 853-7(1953)	1996	7-978	<u>Phys. Rev.</u> <u>90</u> , 633-43(1953)
3265	7-2589	<u>Phys. Rev.</u> <u>89</u> , 977-81(1953)	1997	7-3817	\$0.25

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UCRL	NSA		UR	NSA	
2036	7-2826	\$0.20	205(p.60-71)	6-4700	Part in <u>Biochim et Biophys. Acta</u> <b>10</b> , 349-54(1953)
2040	7-2764	0.25	213(p.55)	6-5541	<u>Am. J. Physiol.</u> <b>171</b> , 762(1952)
2049	7-2843	0.20	214	6-5542	<u>Arch. Biochem. and Biophys.</u> <b>44</b> , 18-29 (1953)
2051	7-3495	0.20	218	7-23	<u>Am. J. Anat.</u> <b>92</b> , 391-431(1953)
2056	7-3304	0.90	219	7-24	<u>Am. J. Anat.</u> <b>92</b> , 433-49(1953)
2076	7-2364	0.10	221	7-1047	<u>J. Lab. Clin. Med.</u> <b>41</b> , 918-28(1953)
2077	7-2340	<u>Phys. Rev.</u> <b>90</b> , 682-9(1953)	225	7-758	<u>Arch. Ind. Hyg. and Occupational Med.</u> <b>7</b> , 319-25(1953)
2088	7-3160	\$0.20	237	7-2946	<u>Am. J. Physiol.</u> <b>173</b> , 41-6(1953)
2091	7-2899	0.45	240	7-4002	<u>J. Gerontol.</u> <b>8</b> , 146-9(1953)
2098	7-2656	<u>Phys. Rev.</u> <b>90</b> , 499-500(1953)	243	7-3322	<u>Proc. Soc. Exptl. Biol. Med.</u> <b>82</b> , 67-70 (1953)
2116	7-3030	<u>J. Am. Chem. Soc.</u> <b>75</b> , 1867-8(1953)	380	7-2961	<u>Arch. Ind. Hyg. and Occupational Med.</u> <b>7</b> , 508-15(1953)
2117	7-3231	\$0.20			
2120	7-3837	<u>Phys. Rev.</u> <b>90</b> , 723-4(1953)			
2126	7-3285	\$0.10			
2154	7-3404	0.25			
2170	7-3921	<u>Phys. Rev.</u> <b>90</b> , 1129-30(1953)			
2173	7-3261	<u>Phys. Rev.</u> <b>90</b> , 1124-5(1953)			
UR			WASH		
191	6-2823	<u>Pediatrics</u> <b>11</b> , 294-303(1953)	129	7-2799	\$1.15

## NEW NUCLEAR DATA

The New Nuclear Data presented here has been prepared by the Nuclear Data Group which has been reorganized under the sponsorship of the National Research Council with the support and cooperation of the National Bureau of Standards. The literature coverage has been continuous with that of the past. New Nuclear Data lists will not appear in the fall numbers of NSA. However, in this period the group will be at work on current data for inclusion in a 1953 cumulation which will appear in Vol. 7, No. 24B.

Summary of New Nuclear Data on Half Lives, Radiations, Relative Isotopic Abundances, Nuclear Moments, Neutron Cross Sections, Reaction Energies, and Masses.

Prepared by National Research Council Nuclear Data Group with assistance of Readers.

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### ABBREVIATIONS

$a$	absorption measurement	$E_{\text{dis}}$	disintegration energy
$a\beta\gamma$	absorption of $\beta$ 's in coincidence with $\gamma$ 's	EA	electrostatic analyzer
$ace^-$	absorption of conversion electrons	E1, E2, ...	electric dipole, electric quadrupole
a coin	measurement by placing absorbers between counters in coincidence	$\epsilon$	electron capture
$\alpha$	total $\gamma$ -ray conversion coefficient, $N_e/N_\gamma$	$\epsilon_K, \epsilon_L$	electron capture from K, L shell
$\alpha_K, \alpha_L, \dots$	$\gamma$ -ray conversion coefficient for electrons ejected from the K, L, ... shell	f	fission, in abbreviations for methods of production or detection
b	coefficient in angular correlation function, $1 + b \cos^2 \theta$	F-K	Fermi-Kurie $\beta$ energy distribution plot
B	band spectra method	$\gamma(\theta, T)$	numbers of $\gamma$ 's as function of angle and temperature
Be $\gamma\gamma$	measurement by detection of photoneutrons from Be	$\Gamma$	resonance half-width (the whole width at half-maximum)
$\beta\gamma, \gamma\gamma$	$\beta\gamma$ or $\gamma\gamma$ coincidences	g.s.	ground state
$\beta\gamma(\theta)$	angular correlation of $\beta$ 's and $\gamma$ 's in coincidence	I	(1) spin in units of $h/2\pi$ ; (2) nuclear induction magnetic resonance method
Calc	calculated value from experimental work reported elsewhere	ic	ionization chamber
cc	cloud chamber	J	quantum state of compound nucleus in a nuclear reaction. "I" is used to denote the spin of the target nucleus, final nucleus
ce $^-$	conversion electrons	K/L	$\alpha_K/\alpha_L$
chem	chemical separation of product following reaction	$l$	angular momentum of particle absorbed into nucleus
Cpt	Compton electrons	M	molecular or atomic beam resonance method
d	(1) deuteron, (2) descendant of, (3) days, when used as superscript	M1, M2, ...	magnetic dipole, magnetic quadrupole...
$d, p(\theta)$	angular distribution of protons with respect to deuteron beam	mb	millibarns
Dyn, D $\gamma p$	measurement by detection of photoneutrons or photoprotons from deuterium	Mic	microwave method
$E$	average energy	mir	measurement by total reflection of neutron beam from mirror surface
$E_0$	resonance energy	ms	mass spectrometer
$E_\beta, E_\gamma, \dots$	energy of $\beta$ ray, energy of $\gamma$ ray, ...	$\mu$	(1) magnetic moment in units of nuclear magnetons, (2) micron, $10^{-4}$ cm

$\mu s$	microseconds	$\sigma_0$	cross section at resonance energy, $E_0$
osc	pile oscillator method	$\sigma_a$	absorption cross section
p	(1) proton, (2) predecessor of	$\sigma_{el}$	elastic scattering cross section
para	paramagnetic resonance method	$\sigma_{in}$	inelastic scattering cross section
pc	proportional counter	$\sigma_s$	scattering cross section
pe-	photo electrons	$\sigma_t$	total cross section
ppl	photoplates or emulsions	t	triton, $H^3$
q	electric quadrupole moment in units of barns	$\tau$	half life in units indicated
Q	reaction energy in Mev	$\tau_{1,2}$	half life of upper, lower state
s	(1) spectrometer method, (2) seconds, when used as superscript	th	thermal
S	atomic-spectra measurement	w, vw	weak, very weak
scin	scintillation counter	(0.123)	$\beta$ and $\gamma$ energy values enclosed in parentheses are given for identification purposes
sl	lens spectrometer	%	% of disintegrations
sl;ce-	conversion electrons measured in lens spectrometer	†	relative numbers. When used in connection with $\gamma$ rays, relative numbers of photons, not photons plus conversion electrons, are meant
st	strong	+,-	even, odd parity
$s\pi$	180° spectrometer		
$s\pi\sqrt{2}$	double focusing spectrometer		
$\sigma$	cross section in barns		

Standard journal abbreviations are used.

All energies are given in Mev and all cross sections in barns unless otherwise stated in the tabular material.

### MAGNETIC MOMENT STANDARDS

In order to have a consistent basis for recording data on magnetic moments, results have been based on the following values and are without diamagnetic corrections.

$$\mu(H^1) = 2.7934 \text{ nuclear magnetons}$$

This value has been adopted arbitrarily because it is the one used as a base in the Table of H. L. Poss, The Properties of Atomic Nuclei, I. Spins, Magnetic Moments and Electric Quadrupole Moments. (Revised, BNL-26 (T-10), (unclassified).) The values reported in the New Nuclear Data summaries are thus directly comparable with those listed in the survey of Poss.

$$\nu(Na^{23})/\nu(H^1) = 0.26450 \quad E. Bleuler, M. Gabriel, Helv. Phys. Acta 20, 67 (1947).$$

$$\nu(D)/\nu(H^1) = 0.153506 \quad F. Bloch, E. C. Levinthal, M. E. Pachard, Phys. Rev. 72, 1125 (1947).$$

$$\nu(B^{11})/\nu(H^1) = 0.320827 \quad D. A. Anderson, Phys. Rev. 76, 434 (1949).$$

### NEW NUCLEAR DATA

$H^2$	$\mu$	0.857608	I
1 1	$\mu(D) / (H^1) = 0.307012192 \pm 0.000000015$		$H^1 H^2$
	T. F. Wimett, <u>Phys. Rev.</u> 91, 499A (1953).		
	Capture $\gamma$	$H^1(n, \gamma)$	$E_n = \text{th scin}$
		2.23	
	No lower energy $\gamma$ 's observed		

A. Bracci, U. Facchini, A. Malvicini, Phys. Rev. 90, 162 (1953); Nuovo Cim. 10, 949 (1953).

$He^4$	$H^3(d, n)$	$E_d = 0.20$	ppl
2 2	No level between 1 and 13 Mev	$(\sigma/\sigma_{g.s.}) < 0.015$	

L. Rosen, Nucleonics 11, No. 8, 38 (1953).

$He^4$	$H^3(p, n) He^3$	$E_p = 1 \text{ to } 5$
	Broad max. at $\sim 3$	long counter
	$p, n(\theta)$ indicates $l_p = 1$ predominant	
	H. B. Willard, J. K. Bair, J. D. Kington, <u>Phys. Rev.</u> 90, 865 (1953).	

$He^4$	$H^3(p, \gamma)$	$E_p = 1 \text{ to } 5.2$
	No resonance for production of $\sim 20$ -Mev $\gamma$ 's	
	Yield curve flattens at $E_p \sim 3.5$	scin

H. B. Willard, J. K. Bair, J. D. Kington, Phys. Rev. 90, 865 (1953).

${}^5\text{He}$	2 3	Levels	$\text{Li}^7(\text{d},\alpha)$	$E_d = 0.98$	ppl
			g.s. $\Gamma = 0.3$		
			2.5 $\Gamma = 1.6$		

P.Cuer, J.J.Jung, Compt. rend. 236, 1252 (1953).

${}^6\text{He}$	2 4	( $\beta$ ) ( $\text{Li}^6$ ) ( $\theta$ ), $\text{Li}^6$ time of flight spectra, suggest $\beta$ -neutrino angular correlation of tensor interaction
		J.S. Allen, W.K.Jentschke, Phys. Rev. 89, 902A (1953).
		( $\beta$ ) ( $\text{Li}^6$ ) ( $\theta$ ) indicates tensor predominates over axial vector interaction Noy (<3%).

B.M.Rustad, S.L.Ruby, Phys. Rev. 89, 880 (1953).

${}^3\text{Li}$	3 2	Level	$\text{He}^3(\text{d},\text{p})\text{He}^4$	$E_d = 0.26$ to 3.6	
			16.80 $J = 3/2^+$	scin	
		$\sigma_{\text{max}} = 0.90$ for $E_d = 0.43$			

J.L.Yarnell, R.H.Lovberg, W.R.Stratton, Phys. Rev. 90, 292 (1953).

${}^6\text{Li}$	3 3	No reaction $\text{Li}^6(\gamma,\text{d})\text{He}^4$	pc
		$\sigma \leq 8.5 \times 10^{-3}$ for $E_\gamma = 2.62$	enriched $\text{Li}^6$
		P.Jensen, K.Gis, Z-Naturf. 8a, 137 (1953).	

${}^7\text{Li}$	3 4	Level	$\text{Be}^9(\text{d},\alpha\gamma)$	$E_d = 0.40$	scin
		$\alpha\gamma(\theta)$	(0.478) $I = 1/2$		

R.G.Uebergang, N.W.Tanner, Australian J. Sci. Res. 6A, 53 (1953).

Resonances	$\text{Li}^7(\gamma,\text{t})\text{He}^4$	$E_\gamma \leq 15$	ppl
	~5.25	$\sigma \approx 0.02$ mb	
	7.25	$\sigma = 0.18$ mb	
	~9.25	$\sigma \approx 0.02$ mb	

P.Stoll, W. Wächter, Nuovo Cim. 10, 347 (1953).

${}^6\text{Li}$	n, t( $\theta$ )	$\text{He}^4$	$E_n = 0.2$ to 0.6	
			shows $I_n = 0$ and 1 predominant	ppl

L.E.Darlington, J.Haugnes, H.M.Mann, J.H.Roberts, Phys. Rev. 89, 892A; 90, 1049 (1953).

${}^8\text{Li}$	3 5	$\tau = 0.898$	$\text{Li}(0.58\text{-Mev d})$	
		(12.5 $\beta$ ) (1.5 $\alpha$ ) ( $\theta$ )	indicates $I = ?-, >0, 0$	
		No 4.87 (<0.8% of $\text{Li}^8$ decays)		

D.S.Bunbury, Phys. Rev. 90, 1121 (1953).

${}^7\text{Be}$	4 3	$\text{Li}^7(\text{D},\text{n})\text{Be}^7$	EA
		Threshold $1.8816 \pm 0.0010$	
		$\text{Li}^7(\text{p},\text{n})$ thresh/Mg $^{24}(\text{p},\text{p}\gamma)$ thresh $= 1.3737 \pm 0.0005$	

K.W.Jones, M.T.McEllistrem, R.A.Douglas, H.T.Richards, Phys. Rev. 91, 482A (1953).

$\tau$ (metal)	53.61 <sup>d</sup>	$\text{Li}(8.5\text{-Mev p})$	
Counted for 5 months		differential ic	
$\tau$ dependent on chemical state			

J.J.Kraushaar, E.D.Wilson, K.T.Bainbridge, Phys. Rev. 90, 610 (1953).

${}^8\text{Be}$	4 4	$\tau < 5 \times 10^{-14}s$	${}^{16}\text{O} (< 27\text{-Mev } \gamma)$
		From analysis of 38 4 $\alpha$ -stars	

C.H.Millar, A.G.W.Cameron, Can.J.Phys. 31, 723 (1953).

${}^8\text{Be}$	4	Levels	$\text{B}^{10}(\gamma,\text{d})$	$\text{B}^{11}(\gamma,\text{t})$
			2.2	$4.0 \quad E_\gamma \leq 31$
			2.9	4.9
			3.4	6.8

All  $\alpha$  emitting levels

P.Erdős, P.Scherrer, P. Stoll, Helv. Phys. Acta 26, 207 (1953).

Levels	$\text{B}^{11}(\text{p},\alpha)$	$E_p = 0.163$
	2.2	4.0
	2.9	4.9
	3.4	6.8

H.Glättli, P.Stoll, Helv. Phys. Acta 26, 428 (1953).

Levels	$\text{B}^{10}(\text{d},\alpha)$	$E_d = 1.0$	s
	2.87	$\Gamma = 0.9$	
	4.1?		
	~5.0		
	~7.5		
	9.6?		

All  $\alpha$  emitting levels  $\text{B}^{10}(\text{d},3\alpha) < 5\%$

P.Cuer, J.J.Jung, Compt. rend. 236, 2401 (1953).

Levels	$\text{C}^{12}(\gamma,\alpha)$	$E_\gamma \geq 26$	ppl
$\gamma\alpha(\theta)$	2†	g.s.	
$\alpha\alpha(\theta)$	10† (3-16)		
	12† 16.4?		
	56† 16.8 $J=2^+$	$\Gamma < 0.3$	$T=1$
	20† 17.6 $J=(2\text{ or }4)^+$	$\Gamma < 0.3$	$T=1$

$\gamma/\alpha < 0.25$  for 16.8 and 17.6 levels

Initial  $\alpha$ 's from  $> 25\text{-Mev}$  levels in  $\text{C}^{12}$

J.J.Wilkins, F.K.Goward, Proc. Phys. Soc. 66A, 661 (1953).

Levels	See $\text{C}^{12}$
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D.L.Livesey, C.L.Smith, Proc. Phys. Soc. 66A, 689 (1953).

${}^9\text{B}$	5 4	Level	$\text{Be}^9(\text{p},\text{n})$	$E_p = 6.59$	ppl
			2.37		

F.Ajzenberg, C.M.Brauns, W.W.Buechner, Phys. Rev. 91, 674; 91, 463A (1953).

${}^{10}\text{B}$	5 5	q	$\pm 0.099$	$\text{B}(\text{CH}_3)_3$	quad res

H.G.Dehmelt, Z.Phys. 134, 642 (1953); 135, 528 (1952).

Capture $\gamma$ 's	$\text{Be}^9(\text{p},\gamma)$	scin
	7.48 level $E_p = 0.998$	

28†	0.41	28†	1.4
228†	0.72		7.5
64†	1.02		

7.56 level  $E_p = 1.087$

108†	0.71	17†	~2
<5†	1.4	98†	6.8

No 0.41 $\gamma$  (<0.8†) No 1.02 $\gamma$  (<5†) No 7.56 $\gamma$

W.F.Hornýak, T.Cochr, Phys. Rev. 91, 463A (1953); verbal report.

<b>B<sup>10</sup></b>	$\gamma\gamma$	Be <sup>9</sup> (d,n)	scin
5 5	(1.02y) (0.72y)	(1.43y, 2.87y) (0.72y)	
S.M.Shafroth, S.S.Hanna, Phys. Rev. 91, 483A (1953).			

Levels	Be <sup>9</sup> (d,n)	$E_d = 0.60$	ppl
130†	g.s.	200†	2.20
380†	0.73	80†	2.85
25†	1.75	170†	3.64

† rel  $\sigma$  at 90°

A.J.Dyer, J.R.Bird, Australian J. Phys. 6, 45 (1953).

<b>B<sup>11</sup></b>	q	+0.047	B(CH <sub>3</sub> ) <sub>3</sub> quad res
5 6	H.G.Dehmel, Z.Phys. 134, 642 (1953); 133, 528 (1952).		

Levels	C <sup>13</sup> (d,α)	$E_d = 1.8$	
γ's	4.50		pair s
	4.96		

R.P.Bent, T.W.Bonner, R.F.Sipple, Phys. Rev. 91, 472A (1953); verbal report.

Levels	B <sup>10</sup> (d,p)	$E_d = 4.25$ to 8.52	
	7.99	9.19	sm
	8.57	9.28	
	8.93	10.32	double?

M.W.Eikind, A.Sperduto, Phys. Rev. 91, 463A (1953); verbal report.

Levels	Be(d,n)	$E_d = 0.96$	ppl
d,n(θ)	~16.7	J = 3/2+	
	~16.7	J = 5/2-	

J.S.Pruitt, S.S.Hanna, C.D.Swartz, Phys. Rev. 91, 463A (1953).

<b>B<sup>12</sup></b>	Levels	B <sup>11</sup> (d,p)	$E_d = 4.25$ to 8.52	
5 7		0.95	2.72	sm
		1.67	3.38	
		2.62		

M.W.Eikind, A.Sperduto, Phys. Rev. 91, 463A (1953); verbal report.

<b>C<sup>12</sup></b>	γ's	Be <sup>9</sup> (α, nγ)	
6 6	3†	3.16	
	100†	(4.43)	

No 7.6y (< 0.04†)

L.E.Beghian, H.H.Halban, T.Husain, L.G.Sanders, Phys. Rev. 90, 1129 (1953).

Levels	C <sup>12</sup> (γ, 3α)	$E_\gamma \leq 70$	ppl
40†	12.7	110†	19.5
35†	13.8	35†	20.7
115†	15.0	130†	21.9
110†	15.9	30†	23.2
125†	16.8	230†	24.3
190†	17.3	130†	25.4
330†	18.3	270†	26.5
130†	18.9	st	29.4

F.K.Goward, J.J.Wilkins, Proc. Roy. Soc. 217A (1953); Proc. Phys. Soc. 65A, 671 (1952).

<b>C<sup>12</sup></b>	B <sup>11</sup> (p,γ)C <sup>12</sup>	EA
Resonance Level	0.1638 ± 0.0002	$\Gamma = 0.0073$
	16.099	absolute measurement

S.E.Hunt, W.W.Jones, Phys. Rev. 89, 1283 (1953).

Levels	B <sup>11</sup> (p,α)	$E_p = 0.4$ to 2.8 s
<u>Yield†</u>	<u>Level</u>	<u>J</u>
35.4/0.04	16.57	2-
8.8/1.0	17.22	2+
2.3/1.4	17.8	0+?
110.5/2.6	18.3	0.30

†Relative yield (Be<sup>8</sup>3-Mev level) / (Be<sup>8</sup>g.s.) $\sigma$

E.B.Paul, R.L.Clarke, Phys. Rev. 91, 463A (1953).

Levels	B <sup>11</sup> (p,γ)	$E_p = 0.6$ to 2.8 s
D,γ(θ)	(16.57)	J=2-
	(17.22)	J=(2+)
	17.8	J=0+
	18.3	J=2+

H.E.Gove, E.B.Paul, Phys. Rev. 91, 463A (1953); verbal report.

Levels in O<sup>16</sup>, C<sup>12</sup>, Be<sup>8</sup> connected by α emission

O <sup>16</sup>	C <sup>12</sup>	Be <sup>8</sup>	DPL
20-24	9.6	g.s.	
20-24	11.3	g.s.	
20-24	12	~5	
—	15-19	~5	
—	>25	~17	
25	—	~4.3	0 <sup>16</sup> → 2Be <sup>8</sup> ?
28-30	16	~5?	

$E_\gamma \leq 26$  to 32

D.L.Livesey, C.L.Smith, Proc. Phys. Soc. 66A, 689 (1953).

O<sup>16</sup>(γ, 4α)  $E_\gamma \leq 48$  ppl

Reaction proceeds 90% via 16-Mev C<sup>12</sup> level for  $E_\gamma > 25$

C.A.Hsiao, V.L.Tellegdi, Phys. Rev. 90, 494; 91, 473A (1953).

C<sup>12</sup>(γ,α)Be<sup>8</sup>  $E_\gamma \leq 27$  ppl

$\sigma(Be^8g.s.) / \sigma(Be^8\gamma\sim 3-Mev level) = \sim 0.09$

C.H.Millar, A.G.Cameron, Can. J. Phys. 31, 723 (1953).

<b>C<sup>13</sup></b>	Levels	C <sup>12</sup> (d,p)	$E_d = 7.86$	DPL
6 7	d,p(θ)	g.s. $I_n = 1$	$\sigma = 0.09$	
		(3.09) $I_n = 0$	$\sigma = 0.12$	

J.Catalá, F.Senent, J. Casanova, Anales real soc. españ. fis. y quím. 49A, 91 (1953).

Capture γ C<sup>12</sup>(n,γ) pair s

4.949 ± 0.006

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 537 (1953).

$\text{C}^{13}_7$ 

Levels	$\text{Be}^9(\alpha, \text{ny}) \text{C}^{12}$	$E_\alpha = 3.0$	scin
Level	$E_\alpha$		
11.98	1.90		
W 12.50	2.65		

F.L.Talbott, N.P.Heydenburg, Phys. Rev. 90, 186 (1953).

 $\text{C}^{14}_6$ 

Levels	$\text{F-K}$ plot linear to 25 kev	scin
C.S.Wu, A.Schwarzschild, Phys. Rev. 91, 483A (1953)		

$\text{C}^{13}(\text{d}, \text{p})$   $E_d = 1.8$  pair s

No 4.1 pair emitting level found

R.D.Bent, T.W.Bonner, R.F.Sipple, Phys. Rev. 91, 472A (1953).

Levels  $\text{C}^{13}(\text{d}, \text{p})$   $E_d = 4.06$  ppl  
 $\text{d}, \text{p}(\theta)$  (8.1)  $l_n = 0$

R.E.Benenson, Phys. Rev. 90, 420 (1953).

 $\text{N}^{13}_7$ 

$\text{C}^{12}(\text{p}, \gamma) \text{N}^{13}$  EA

Resonance  $0.4568 \pm 0.0005$   $\Gamma = 0.040$   
 Level 2.367 absolute measurement

S.E.Hunt, W.W.Jones, Phys. Rev. 89, 1283 (1953).

 $\text{N}^{14}_7$ 

Levels  $\text{C}^{13}(\text{d}, \text{n})$   $E_d = 3.89$  ppl  
 $\text{d}, \text{n}(\theta)$  Level  $l_p$

2.2 1  
 3.85 1  
 4.80 0  
 4.97 1?  
 5.5 0?  
 5.76  
 6.1  
 6.23  
 6.43  
 7.00 1?  
 7.50 0?  
 8.08

R.E.Benenson, Phys. Rev. 90, 420 (1953).

Capture  $\gamma$ 's  $\text{C}^{13}(\text{p}, \gamma)$   $E_p = 0.554$  scin  
 ~25† 2.35 ~10† 4.45  
 ~10† 2.75 ~4† 5.1  
 ~15† 3.05 100† (8.06)

D.Hicks, T.Husain, L.G.Sanders, L.E.Beghian, Phys. Rev. 90, 163 (1953).

$\gamma$ 's  $\text{C}^{13}(\text{d}, \gamma)$   $E_d = 1.8$  pair s  
 3.36 5.72  
 5.13 6.14?

R.D.Bent, T.W.Bonner, R.F.Sipple, Phys. Rev. 91, 472A (1953); verbal report.

Levels  $\text{N}^{14}(\alpha, \alpha')$   $E_\alpha = 21.2$  a  
 4.10 7.03  
 5.22 7.95  
 5.72 8.64  
 6.01 9.23

2.31 level not observed (isotopic spin forbidden)

B.W.Carmichael, W.B.Sampson, O.E.Johnson, Phys. Rev. 91, 473A (1953); verbal report.

 $\gamma \text{N}^{14}_7$ 

Levels	$\text{C}^{13}(\text{p}, \text{n}) \text{N}^{13}$	$E_p = 3.2$ to 5.0	
Level	$E_\alpha$	$\Gamma$	pc
11.05	3.78	0.10	
11.26	4.01	0.02	
11.35	4.10	0.15	
11.44	4.18	0.03	
11.74	4.52	0.12	
12.0	4.8	0.10	

J.K.Bair, J.D.Kington, H.B.Willard, Phys. Rev. 90, 575 (1953).

Levels	$\text{B}^{10}(\alpha, \text{p}\gamma) \text{C}^{13}$	$E_\alpha = 3.0$	
Level	$E_\alpha$		
12.68	1.50		
12.77	1.63		
12.81	1.68		
12.92	1.83		
13.17	2.18		
~13.23	~2.27		
~13.72	~2.95		

F.L.Talbott, N.P.Heydenburg, Phys. Rev. 90, 186 (1953).

 $\text{N}^{15}_7$ 

Levels	$\text{N}^{14}(\text{d}, \text{p})$	$E_p = 5$ to 8	s
7.58	9.16	10.53	
8.31	10.06	10.69	
8.57	10.45	10.80	
9.05			

A.Sperduto, W.W.Buechner, M.M.Elkind, W.J.Fader, Phys. Rev. 473A (1953); verbal report.

Levels  $\text{C}^{14}(\text{p}, \text{n})$

$\text{p}, \text{n}(\theta)$  (11.294)  $J = 1/2(-?)$   
 (11.429)  $J = 1/2+$   
 (12.098)  $J = 5/2-$   
 (12.147)  $J = 3/2-$   
 (12.327)  $J = 5/2\pm$

R.Kay, H.Mark, C.Goodman, Phys. Rev. 91, 472A (1953); verbal report.

Levels  $\text{N}(\text{n}, \text{n})\text{N}$

$\text{n}, \text{n}(\theta)$  (12.327)  $l_n = 1$   
 (12.494)  $l_n = 2$

J.L.Fowler, C.H.Johnson, J.R.Risser, Phys. Rev. 91, 441A (1953); verbal report.

 $\text{N}^{16}_7$ 

NO 1.0Y (<5% of 6.0Y) 0(fast n) scin

F.Boehm, D.C.Pearcey, V.Perez-Mendez, Phys. Rev. 90, 1119 (1953).

 $\text{O}^{16}_8$ 

$\gamma$ 's  $\text{F}^{19}(\text{p}, \alpha\gamma)$   $E_p = 0.874$ , 0.935 scin

(8.91Y)/(possible 0.78Y from 6.91 level)  $\geq 200$   
 (7.12Y)/(possible 0.98Y from 7.12 level)  $\geq 120$   
 (7.12Y)/(possible 1.06Y from 7.12 level)  $\geq 100$   
 Results consistent with small T=1 admixture in levels involved (expected from Coulomb perturbation)

O.H.Wilkinson, G.A.Jones, Phil Mag. 44, 542 (1953).



$^{26}_{12}\text{Mg}^{14}$ 

Level	$\gamma$ 's		
3.97	2.14	(3.97) (vw)	1.83
4.35	1.38	1.14	1.83

Presence of 0.44 level in doubt

J.E.Way, B.P.Foster, Phys. Rev. 90, 243; 90, 370A (1953).

 $^{27}_{12}\text{Mg}$ 

Capture $\gamma$	$\text{Mg}(n,\gamma)$	pair s
18 $\dagger$	6.440	

Assignment by agreement with d,p results

†Photons per 100 n captures in  $\text{Mg}^{26}$ 

Other lines not remeasured

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 901 (1953).

 $^{28}_{12}\text{Mg}$ 

$\beta^-$	0.40	$\text{Mg}(39\text{-Mev})$	a
$\gamma$	~0.03	chem	scin
30 $\dagger$	0.40		
28 $\dagger$	0.95		
71 $\dagger$	1.35		

R.K.Sheline, N.R.Johnson, Phys. Rev. 90, 325, (1953).

 $\tau$  20.8 $^h$   $\text{Si}, \text{K}(420\text{-Mev p})$   
 $\beta^-$  0.42 F-K plot linear chem; slNo other  $\beta$  (<10%)

L.Marquez, Phys. Rev. 90, 330 (1953).

 $\tau$  22.1 $^h$   $\text{Si}(350\text{-Mev p})$  a  
 $\beta^-$  0.3  $\text{p} 2.3^m \text{Al}$  chem; scinSeveral  $\gamma$ 's up to 2.6 Mev scin

J.W.Jones, T.P.Kohman, Phys. Rev. 90, 495 (1953).

 $\tau$  21.4 $^h$   $\text{Mg}(56\text{-Mev } \alpha)$   
 $\beta^-$  0.39 a  
 $\gamma$  70 $\dagger$  0.032  $\alpha < 1$  scin†Photons per 100  $\text{Mg}^{28}$  decays

A.H.Wapstra, A.L.Veenendaal, Phys. Rev. 91, 426 (1953).

 $^{24}_{13}\text{Al}$ 

$\tau$	2.10 $^s$	$\text{Mg}(20\text{-Mev p})$
$\gamma$	2.9	scin
	4.3	
	5.3	
	7.1	

N.W.Glass, L.K.Jensen, J.R.Richardson, Phys. Rev. 90, 320 (1953).

 $^{25}_{13}\text{Al}$ 

Resonance	$\text{Mg}^{24}(\text{p},\gamma)\text{Al}^{25}$	EA
	0.4180 $\pm 0.0005$	$\Gamma = 0.0040$ absolute measurement

S.E.Hunt, W.M.Jones, Phys. Rev. 89, 1283 (1953).

 $^{27}_{13}\text{Al}$ 

$\tau$	40.149	I

H.Lew, G.Wessel, Phys. Rev. 90, 1 (1953).

 $^{13}\text{Al}^{27}_{14}$ 

Levels	$\text{Al}(n,\gamma)$	$E_n = 14$	scin
$\gamma$	0.81?		$n^{\gamma}$
	1.03		
	2.34		

R.E.Garrett, F.L.Herford, B.W.Sloope, Phys. Rev. 91, 441A (1953); verbal report.

Resonances  $\text{Mg}^{26}(\text{p},\gamma)\text{Al}^{27}$  EA

$E_0$	$\Gamma$
0.3148 $\pm 0.0005$	0.004
0.3385 $\pm 0.0005$	0.002
0.3894 $\pm 0.0005$	0.004
0.4365 $\pm 0.0004$	0.004
0.4542 $\pm 0.0003$	<0.001
( $\text{Al}^{27}$ ?) 0.484 $\pm 0.0010$	0.010

absolute measurement

\*Assignment from Tangen who found no  $\beta$ 

S.E.Hunt, W.M.Jones, Phys. Rev. 89, 1283 (1953).

 $^{28}_{13}\text{Al}$ 

$\tau$	2.27 $^m$ $\pm 0.02$	$\text{Al}(\text{pile } n)$
13 15	Counted 5 samples each for 5 half-lives	

R.M.Bartholomew, F.Brown, W.D.Howell, W.R.J. Shorey, L.Yaffe, Can. J. Phys. 31, 714 (1953).

 $\beta^-$  2.85 d 21 $^h$   $\text{Mg}$  chem; sl  
F-K plot linear

L.Marquez, Phys. Rev. 90, 330 (1953).

 $\gamma$  1.78 d 21 $^h$   $\text{Mg}$  scin

R.K.Sheline, N.R.Johnson, Phys. Rev. 90, 325 (1953).

Si

Relative abundances	SiF <sub>4</sub> ; ms
A 28 29 30	
% 92.18 4.71 3.12	

J.H.Reynolds, Phys. Rev. 90, 1047 (1953).

 $^{27}_{14}\text{Si}$ 

$\tau$	4.45 $^s$	$\text{Si}(<25\text{-Mev } \gamma)$
14 13		

R.G.Summers-Gill, R.N.Haslam, L.Katz, Can. J. Phys. 31, 70 (1953).

 $^{28}_{14}\text{Si}$ 

Resonances	$\text{Al}^{27}(\text{p},\gamma)\text{Si}^{28}$	EA
	$E_0$	$\Gamma$
	0.226 $\pm 0.0015$	$\sim 0.001$
	0.294 $\pm 0.0005$	<0.001
	0.3256 $\pm 0.0004$	<0.001
	0.4047 $\pm 0.0004$	0.0007
	0.4385 $\pm 0.0005$	<0.001
	0.5040 $\pm 0.0006$	0.0007

absolute measurements

S.E.Hunt, W.M.Jones, Phys. Rev. 89, 1283 (1953).

 $^{29}_{14}\text{Si}$ 

Levels	$^* \text{Si}(\text{d},\text{p})$	$E_d = 8.21$ a pc
$d, p(\theta)$	Level	$l_n$
	g.s	0
	(1.278)	2
	(2.027)	2
	(2.426)	2.4
	*	0.7

$^{14}\text{Si}^{29}$ 

Level	$l_n$	$d\sigma/d\Omega \dagger$
(3.070)	2	1.2
(3.623)	3	4.0
(4.934)	1	55
(6.380)	1	32

$\dagger$  mb/sterad at maximum of angular distribution  
 $\ast$  angular distribution isotropic

J.R.Holt, T.H.Marsham, Proc. Phys. Soc. 66A, 467 (1953); Phys. Rev. 89, 665 (1953).

 $^{14}\text{Si}^{29}$ 

14 15

Resonances	Mg( $\alpha, n$ )Si	$E_d = 5.3$	a
		4.6	
		4.8	

Excitation function given

J.Nagy, Acta Physica Acad. Sci. Hung. 3, 15 (1953).

 $^{14}\text{Si}^{30}$ 

14 16

Levels	$\text{Si}(d, p)$	$E_d = 8.21$	a pc
$d, p(\theta)$	(5.07) $l_n = 0$		
	(5.50) $l_n = 0$ or 2		

J.R.Holt, T.H.Marsham, Proc. Phys. Soc. 66A, 467 (1953).

 $^{14}\text{Si}^{31}$ 

14 17

Levels	$\text{Si}(d, p)$	$E_d = 8.21$	a pc
$d, p(\theta)$	(0.757) $l_n = 0$		
	(1.699) $l_n = 0$ or 2		

J.R.Holt, T.H.Marsham, Proc. Phys. Soc. 66A, 467 (1953).

 $^{14}\text{Si}^{32}$ 

14 18

Abundance  $< 4 \times 10^{-6}\%$  of natural silicon  
 No  $\text{P}^{33}$   $\beta^+$ 's observed,  $\text{Si}^{32}(n, \gamma) \text{Si}^{33} \rightarrow \text{P}^{33}$   
 Assumed  $\sigma(n, \gamma) = 0.05$

A.Turkevich, A.Tompkins, Phys. Rev. 90, 247 (1953).

 $^{15}\text{P}^{28}$ 

15 13

$\tau$	$0.28^s$	$\text{Si}(20\text{-Mev} p)$	
$\beta^+$			scin
$\gamma$	7		
NO $\alpha$ ( $< 10\%$ of $\gamma$ )			

N.W.Glass, L.K.Jensen, J.R.Richardson, Phys. Rev. 90, 320 (1953).

 $^{15}\text{P}^{29}$ 

15 14

$\beta^+$	3.9	$\text{Si}(6\text{-Mev} d)$	scin
M.Nahmias, T.Yuasa, Compt. rend. 236, 2399 (1953).			

 $^{15}\text{P}^{32}$ 

15 17

$e^+e^-$ ( $H_p = 1600$ )	$< 10^{-5}$	s
G.W.McClure, Phys. Rev. 91, 483A (1953).		

 $^{16}\text{S}^{32}$ 

16 16

Level	$S(n, n'\gamma)$	$E_n = 14$	scin
$\gamma$	2.32	$n'\gamma$	

R.E.Garrett, F.L.Herford, B.W.Sloope, Phys. Rev. 91, 441A (1953); verbal report.

 $^{16}\text{S}^{33}$ 

16 17

Levels	$S^{32}(d, p)$	$E_d = 8.18$	a pc
$d, p(\theta)$	Level $l_n$	$d\sigma/d\Omega \dagger$	
	g.s. 2	7.1	
	0.85 0	39	
	1.86 *	0.8	
	2.28 *	1.3	
	2.90 3	14	
	3.26 1	83	

 $^{16}\text{S}^{33}$ 

16 17

Level	$l_n$	$d\sigma/d\Omega \dagger$
3.91	—	1.5
4.21	1	15
4.89	1	9.4
5.72	1	100
6.48**	1 and 2	41
7.44		
7.83		

$\dagger$  Relative at maximum of angular distribution

$*$  Angular distribution isotropic

$**$  Level is a doublet

J.R.Holt, T.H.Marsham, Proc. Phys. Soc. 66A, 467 (1953); Phys. Rev. 89, 665 (1953).

Level  $A^{36}(n, \alpha)$   $E_n = 2.15$  to 4.40  
 $l_n = 0.2$  pc

B.J.Toppel, S.D.Bloom, Phys. Rev. 91, 473A (1953).

$^{31}\text{Cl}^{32}$   $\tau$   $0.306^s$   $S(20\text{-Mev} p)$   
 $\beta^+$  scin  
 $\gamma$  4.8  
 NO  $\alpha$  ( $< 10\%$  of  $\gamma$ )

N.W.Glass, L.K.Jensen, J.R.Richardson, Phys. Rev. 90, 320 (1953).

$^{31}\text{Cl}^{33}$   $\beta^+$  4.2  $S(6\text{-Mev} d)$   
 scin

M.Nahmias, T.Yuasa, Compt. rend. 236, 2399 (1953).

Resonances  $S^{32}(p, p)S^{32}$   $E_p = 1.0$  to 2.8  
 $p, p(\theta)$  1.90  $J=3/2^-$   $\Gamma < 0.025$   
 2.31  $J=1/2^-$   $\Gamma \sim 0.06$

A.J.Ferguson, H.E.Gove, Phys. Rev. 91, 439A (1953).

$^{33}\text{Cl}^{34}$   $\gamma$  (0.145)  $\alpha = 0.18$  M3  
 33<sup>m</sup> W.Arber, P.Stähelin, Helv. Phys. Acta 26, 433 (1953).

$^{31}\text{Cl}^{35}$   $\tau$  1.45<sup>s</sup>  $Cl(\gamma, n)$   
 W.Arber, P.Stähelin, Helv. Phys. Acta 26, 433 (1953).

$^{31}\text{Cl}^{36}$  Capture  $\gamma$ 's  $Cl(n, \gamma)$  2 cryst scin s  
 35† 0.70 14† 2.40  
 29† 1.12 10† 2.68  
 19† 1.77 23† 3.71  
 2.03 4.67

W.A.Reardon, R.W.Krone, R.Stump, Phys. Rev. 91, 334; 91, 442A (1953).

A Neutron resonances (MeV)  $E_n = 0.4$  to 1.1  
 $E_n$   $\sigma_n$   
 0.58  $\sim 3.5$

0.60  $\sim 3.5$

0.74  $\sim 3.5$

J.B.Guerney, C.Goodman, Phys. Rev. 91, 440A (1953)  
 verbal report.

$A^{37}$   
18 19  $\tau$  32<sup>d</sup>  $A^{36}$  (pile n)  
E<sub>dis</sub> 0.815 scin a  
continuous  $\gamma$  endpoint  
C.E. Anderson, G.W. Wheeler, W.W. Watson, Phys. Rev. 90, 606 (1953).

$A^{38}$   
18 20  $A^{36}/A^{38}$  variation of >300% for various  
pitchblende ores suggests  $A^{38}$  formation by  
a's or fission n's  
W.H. Fleming, H.G. Thode, Phys. Rev. 90, 857 (1953).

$A^{41}$   
18 23  $\gamma$  (1.8)  $\tau = 6.8 \times 10^{-9}s$  / $\gamma$   
T.C. Engelder, Phys. Rev. 90, 259 (1953).

$Ca^{39}$   
20 19  $\tau$  1.00<sup>s</sup> Ca (< 25-Mev  $\gamma$ )  
R.G. Summers-Gill, R.M.H. Haslam, L. Katz, Can. J. Phys. 31, 70 (1953).

$\tau$  1.00<sup>s</sup> Ca (< 30-Mev  $\gamma$ )  
 $\beta^+$  6.7 a  
R.Braams, C.L. Smith, Phys. Rev. 90, 995 (1953).

$Ca^{40}$   
20 20 Levels Ca(p,p') E<sub>p</sub> = 6.92 to 8.15  
3.35 3.90 s  
3.71 4.49  
C.M. Braams, C.K. Bockelman, C.P. Browne, W.W. Buechner, Phys. Rev. 91, 474A (1953); verbal report.

$Ca^{41}$   
20 21 Levels Ca(d,p) E<sub>d</sub> = 8.13 pp1  
d,p( $\theta$ ) Level I<sub>n</sub> d $\sigma/d\Omega$   
g.s. 3 3.8  
1.90 1 23  
2.42 1 10  
2.9  
3.6  
3.96 2 or 1 6  
4.76 2 7.2  
5.72 2 7.8

$\tau$  mb/sterad at maximum of angular distribution

J.R. Holt, T.N. Marsham, Proc. Phys. Soc. 66A, 565 (1953).

$Ca^{43}$   
20 23 I 7/2 I  
 $\mu$  -1.3157

C.D. Jeffries, Phys. Rev. 90, 1130 (1953).

$Ca^{47}$   
20 27  $\tau$  4.8<sup>d</sup>  
p 3.4<sup>d</sup> Sc Ca(th n)  
ion chem  
L.G. Cook, K.D. Shafer, Phys. Rev. 90, 1121 (1953).

$Sc^{43}$   
21 22  $\tau$  3.95<sup>h</sup> Ca(7-Mev p) chem  
J.E. Duval, M.M. Kurbatov, J. Am. Chem. Soc. 75, 2246 (1953).

$Sc^{46}$   
21 23  $\beta^-$  0.22% 1.25 F-K plot not linear s  
F.H. Schmidt, G.L. Kelster, Phys. Rev. 91, 483A (1953).

NO delayed  $\gamma\gamma$  ( $\tau < 1.5 \times 10^{-9}s$ )

C.E. Whittle, F.T. Porter, Phys. Rev. 90, 498 (1953).

$Sc^{47}$   
21 26  $\beta^-$  ~68% 0.435 Tl<sup>49</sup> (10-Mev d)  
~34% 0.622 sl  
 $\gamma$  0.185 scin  
(0.446) ( $\gamma$ ) No (0.626) ( $\gamma$ )

L.S. Cheng, M.L. Pool, Phys. Rev. 90, 886 (1953).

$\tau$  3.44<sup>d</sup> Ca(7-Mev p) chem  
J.E. Duval, M.M. Kurbatov, J. Am. Chem. Soc. 75, 2246 (1953).

$Sc^{48}$   
21 27  $\gamma$  100† (0.98) scin  
100† 1.05  
100† (1.33)

FROM comparison with V<sup>48</sup> No 2.2 $\gamma$

W.J. Stark, A.H. Wapstra, R.E.W. Kropveld, Physica 19, 135 (1953).

$\gamma$  16.4<sup>d</sup>  
23 25 (1.32 $\gamma$ ) (0.89 $\gamma$ ) (0) I = 4, 2, 0

F.Meyer, S.Schlieder, Z. Phys. 135, 119 (1953).

$\gamma$  0.98 scin  
1.33  
2.22 ± 0.10  
 $\epsilon/\beta^+ = 0.48$

W.J. Stark, A.H. Wapstra, R.E.W. Kropveld, Physica 19, 135 (1953).

$\gamma$  (0.99)  $\tau < 2 \times 10^{-9}s$  / $\gamma$   
(1.32)  $\tau < 2 \times 10^{-9}s$  / $\gamma$

T.C. Engelder, Phys. Rev. 90, 259 (1953).

$Cr^{49}$   
24 25  $\tau$  41.7<sup>m</sup> Tl(40-Mev  $\alpha$ )  
 $\beta^+$  15† 0.73 chem sl  
35† 1.39  
50† 1.54  
 $\gamma$  0.153  $\alpha_K = 0.02$  M1 ce; pe-  
0.609  $\alpha_K = < 4 \times 10^{-4}$  pe-  
NO 0.782  $\gamma$

B.Crasemann, H.T. Easterday, Phys. Rev. 90, 1124 (1953).

$Cr^{53}$   
24 29  $\mu$  -0.47351 I  
 $\nu$  (Cr<sup>53</sup>) /  $\nu$  (N<sup>14</sup>) = 0.78226 ± 0.00005 Na<sub>2</sub>CrO<sub>4</sub>  
F.Alder, K.Halbach, Helv. Phys. Acta 26, 426 (1953).

$Mn^{56}$   
25 31  $\tau$  2.58<sup>h</sup> ± 0.003 Mn(pile n)  
Counted 2 samples each for 10 half-lives

R.M. Bartholomew, F.Brown, W.D. Howell, W.R.J. Shorey, L. Yaffe, Can. J. Phys. 31, 714 (1953).

$\gamma$  (0.85)  $\tau < 2 \times 10^{-9}s$  / $\gamma$   
T.C. Engelder, Phys. Rev. 90, 259 (1953).

$Fe$   $\gamma$ 's Fe(n,n'γ) E<sub>n</sub> = 14 scin  
0.85 n'γ  
1.29  
1.42  
2.1

R.E. Garrett, F.L. Hereford, B.W. Sloope, Phys. Rev. 91, 441A (1953); verbal report.

$\mu$  <0.05 para  
R.S. Trenam, Proc. Phys. Soc. 66A, 414 (1953).

Fe <sup>59</sup>	$\gamma\gamma(\theta)$	scin	$\gamma$	$C^{67}_{29,38}$	35% 20%	0.484 0.577	
26 33	Agrees with $I = 3/2, 5/2, 7/2$ Excludes $I = 5/2, 3/2, 7/2$					$0.092 \alpha = 0.5$ $0.182 \alpha = 0.012$	E2 M1
	D.Schiff, F.H.Wetzger, Phys. Rev. 90, 849 (1953).						H.T.Easterday, Phys. Rev. 91, 653 (1953).
Co <sup>60</sup>	$\tau = 10.47^m \pm 0.02$ Co(pile n)		$\beta^-$		0.37 0.45 ~55%	Zn(27-Mev d)	$a\beta y$
27 33	Counted 6 samples each for 7 half-lives		$\gamma$		st st W W	0.094 0.19 0.30 0.39	$a\beta y$ a scin
10.7 <sup>m</sup>	R.M.Bartholomew, F.Brown, W.D.Howell, W.R.J.Shorey L.Yaffe, Can. J. Phys. 31, 714 (1953).						
5.2 <sup>y</sup>	$\gamma\gamma(\theta)$ $I=4,2,0$ $b = 0.167$						
	J.S.Lawson, Jr., H.Frauenfelder, W.K.Jentschke, Phys. Rev. 91, 484A; 91, 649 (1953).						
	$\gamma\gamma(\theta)$ $I=4,2,0$ $b = 0.166$						
	S.Chatterjee, A.K.Saha, Z.Phys. 135, 141 (1953).						
	$\gamma$ $(1.17) \tau < 2 \times 10^{-9}s$ $\beta y$ $(1.83) \tau < 2 \times 10^{-9}s$ $\beta y$						
	T.C.Engelder, Phys. Rev. 90, 259 (1953).						
Co <sup>60</sup>	Capture $\gamma$ 's	Co(n, $\gamma$ )	2 cryst	scin s	$Cu^{68}_{29,39}$	$\tau = 32^s$ $\beta^- = \sim 3.0$ $\gamma$ weak	Zn( $\leq 15$ -Mev n) chem; a Ga( $\leq 15$ -Mev n)
27 33	100† 19† 20† 2.39? 19†	0.52 1.30 2.00 3.58					
	W.A.Reardon, R.W.Krone, R.Stump, Phys. Rev. 91, 334; 91, 442A (1953).						
Cu	$\gamma$ 's	Cu(n,n' $\gamma$ )	$E_n = 14$	scin n' $\gamma$	$Zn^{64}_{30,34}$	$\tau_{ee} = > 8 \times 10^{15}y$	
							pc
	1.1 1.55 2.14						
	R.E.Garrett, F.L.Herford, B.W.Sloope, Phys. Rev. 91, 441A (1953); verbal report.						
Cu <sup>61</sup>	$\gamma$ $(0.85) \tau < 2 \times 10^{-9}s$		$\beta y$		$A^{65}_{30,35}$	$\beta^+ = 0.327$ $\gamma/\beta^+ = 28 \pm 6$ $\gamma/\beta^+ = 28 \pm 6$	$Na^{22}$ comparison and $ce/\beta^+$ No $0.20y$ ( $< 3 \times 10^{-4}$ )
29 32	T.C.Engelder, Phys. Rev. 90, 259 (1953).						sl pe-
Cu <sup>63</sup>	Q	-0.16		para			
29 34	B.Bleaney, K.D.Bowers, R.S.Trenam, Proc. Phys. Soc. 66A, 410 (1953).						
Cu <sup>65</sup>	Q	-0.15		para			
29 36	B.Bleaney, K.D.Bowers, R.S.Trenam, Proc. Phys. Soc. 66A, 410 (1953).						
Cu <sup>66</sup>	$\tau = 5.07^m \pm 0.02$ Cu(pile n)				$Ga^{64}_{31,33}$	$\tau = 2.5^m$ $\beta^+ = \sim 5$ $\gamma$	$Zn^{64}(0.1\text{-Mev p})$ chem scin
29 37	Counted for 9 half-lives	$\beta$ electroscope				2.2? 3.8	
	R.M.Bartholomew, F.Brown, W.D.Howell, W.R.J.Shorey, L.Yaffe, Can. J. Phys. 31, 714 (1953).						
	$\gamma$ $(1.04) \tau < 2 \times 10^{-9}s$		$\beta y$				
	T.C.Engelder, Phys. Rev. 90, 259 (1953).						
Cu <sup>67</sup>	$\tau = 61^h$	Ni(40-Mev $\alpha$ )			$Ga^{65}_{31,34}$	$\beta^+ = 90\% 2.1$ 10% 2.52	$Zn(19\text{-Mev d})$ Cu(40-Mev $\alpha$ ) chem; sl
29 38	$\beta^- = 48\% 0.395$	Zn(195-Mev d)	chem; sl				
	B.Crasemann, Phys. Rev. 90, 995 (1953).						

Ga <sup>67</sup>		ε	Zn(p)	ion chem	Se <sup>75</sup>	ε (no β's)	Se (pile n)
31	36	γ	$\alpha_K$	K/L	34 41	γ 0.5% 14% 6.5% ~3% 24% 0.04% 71% 0.269 ~5% 0.03% 14%	sl ce <sup>-</sup> pe <sup>-</sup> K/L=11 $\alpha_K \sim 0.3$ $\alpha_K = 0.12$ 0.203 0.269 $\alpha_K = 0.09$ 0.308 0.405 $\alpha_K = 0.0015$
2.7%	0.090	0.074		M1			No 0.0247 γ (<0.15γ) (γ)
63.9%	0.092	0.63	7.0	E2			No delayed γγ (0.3 <sup>μs</sup> -10 <sup>μs</sup> )
29.6%	0.182	0.011	12.6	M1			Decay scheme proposed
1%	0.206	0.029	~14				
20.2%	0.296	0.0029	7.6	M1			
4.9%	0.388	0.0019		M1			
0.4%	0.496						
0.2%	0.790		sl ce <sup>-</sup> pe <sup>-</sup> , scin				
0.4%	0.880						
(0.206γ) (0.090γ, 0.182γ)		(all γ's) (χ)					
(0.496γ) (0.296γ, 0.388γ)							
(0.090γ, 0.296γ) (0.092γ) delay of 8.5 <sup>μs</sup>							
No other delay (<5x10 <sup>-7</sup> s)							
Decay scheme, spins proposed							
B.H.Ketelle, A.R.Brosil, F.M.Porter, Phys. Rev. 90, 567 (1953).							
Ge		Relative abundances		GeF <sub>4</sub> ; ms	Se <sup>77</sup>	μ	H <sub>2</sub> Se Mic
33	38	A	70	72	73	74	78
			20.52	27.43	7.76	36.54	7.76
J.M.Reynolds, Phys. Rev. 90, 1047 (1953).							
As <sup>71</sup>		τ	60 <sup>h</sup>	Ge (25-Mev d) ms	Se <sup>82</sup>	τ	>10 <sup>17</sup> γ
33	38	β+	W ~0.30?	chem	34 48		No 36 <sup>h</sup> Br detected
			0.82				H.D.Sharma, Curr. Sci. 22, 45 (1953).
γ		0.0233		sl ce <sup>-</sup>			
		0.175					
H. Atterling, S.Thulin, Nature 171, 927 (1953).							
τ		60 <sup>h</sup>	Ge (14-Mev d)	Br <sup>80</sup>	NO γ (γ/β $\leq 1.25$ )		
β+		0.80	chem	35 45	J.Labarrigue-Frolow, R. Bernas, H.Langevin, Compt. rend. 236, 1246 (1953).		
γ		0.175	K/LM = 8.3	18 <sup>m</sup>			
ce <sub>K</sub> <sup>-</sup> /β+ = 0.14							
P.H.Stoker, O.P.Hok, Physica 19, 279 (1953).							
As <sup>72</sup>		γ	0.697	Ge (14-Mev d)	Kr <sup>85</sup>	τ	10.27γ U(n,f) chem ms
33	39		ce <sub>K</sub> <sup>-</sup> /β+ = 0.0090	chem	36 49		From decrease in abundance in seven years
P.H.Stoker, O.P.Hok, Physica 19, 279 (1953).							
As <sup>73</sup>		γ	0.0130	Ge (14-Mev d)	Sr <sup>89</sup>	Levels	sr(d,p) E <sub>d</sub> = 8.01 pp1
33	40		0.053	K/LM=5.2 chem; ce <sup>-</sup>	38 51		
P.H.Stoker, O.P.Hok, Physica 19, 279 (1953).							
γ		0.0135 a=large	τ = 4.0 <sup>μs</sup>	0.000 <sup>μs</sup> < t < 10 <sup>s</sup>	38 53	τ	9.67 <sup>h</sup> U(n,f) chem sl
		0.054		0.0135 γ follows 0.054 γ		β+	0.61
J.P.Welker, A.W.Schardt, J.J.Howland, Jr., G.Friedlander, Phys. Rev. 91, 484A (1953).							
As <sup>75</sup>		No isomeric state observed after 5 min. separation of As from Se <sup>75</sup>					
33	42						
E.N.Jensen, L.J.Laslett, D.S.Martin, Jr., F.J. Hughes, W.W.Pratt, Phys. Rev. 90, 557 (1953).							
As <sup>76</sup>		(2β) (~0.6γ) (θ)	b = 0.076	scin	39 49	γ (0.908γ) (1.85γ) (θ) (E) 1 (M) 2 < 0.001%	
33	43						
H.Rose, Phil. Mag. 44, 739 (1953).							
As <sup>78</sup>							

Y91	$\tau$	50.3 <sup>m</sup>	d 0.7 <sup>h</sup>	Sr chem				
39 52	$\gamma$	0.551	$\alpha_K = 0.046$	$sm ce^-$				
51 <sup>m</sup>			K/LM=8.0	M4				
		NO $\beta^-$ (< 1.5% of IT)						
		D.P. Ames, W.E. Bunker, L.M. Langer, B.M. Sorenson, Phys. Rev. 89, 903A; 91, 68 (1953).						
Zr <sup>95</sup>	$\tau$	65 <sup>d</sup>	Zr <sup>94</sup> (pile n, $\gamma$ )					
40 55	$\beta^-$	~49% 0.360	U(pile n, f)	$sm 2$				
		~49% 0.400						
		~2% 0.910						
	$\gamma$	0.235 K/L = 4.5	$sm ce^-$					
		0.725 K/L = 5						
		0.758						
		J.M. Cork, J.M. LeBlanc, D.W. Martin, W.H. Nestor, M.K. Brice, Phys. Rev. 90, 579 (1953).						
Zr <sup>96</sup>	$T_{1/2}$	$6 \times 10^{16} y$	89.5% Zr <sup>96</sup>	scin				
40 56	$\beta$ or $\gamma$ of 3.8±0.5							
		J.A. McCarthy, Phys. Rev. 90, 853 (1953).						
Nb <sup>95</sup>	$\gamma$	0.235 K/L = 4.5	$sm ce^-$					
41 54		J.M. Cork, J.M. LeBlanc, D.W. Martin, W.H. Nestor, M.K. Brice, Phys. Rev. 90, 579 (1953).						
35 <sup>d</sup>	$T_2$	35.0 <sup>d</sup>	d 65 <sup>d</sup> Zr; chem					
	$\beta^-$	0.165	$sm 12$					
	$\gamma$	0.753	$sm ce^-$					
		0.768 K/L = 7.6						
		Evidence for low energy $\gamma$						
		J.M. Cork, J.M. LeBlanc, D.W. Martin, W.H. Nestor, M.K. Brice, Phys. Rev. 90, 579 (1953).						
Mo <sup>93</sup>	$\gamma$	$\alpha_K^*$ 0.262 0.53	K/L 3.09	$sm ce^-$				
42 51		0.684 $1.5 \times 10^{-3}$	8	M1				
6.7 <sup>h</sup>		1.479 $2.4 \times 10^{-4}$		E2, M1				
		Mo X rays	crit a, cryst					
		*Based on $\alpha$ (0.262 $\gamma$ ) = 0.7						
		C.W. Forsthoft, R.H. Goeckermann, R.A. Naumann, Phys. Rev. 90, 1004 (1953).						
Tc <sup>99</sup>	$\tau$ (metal)	6.04 <sup>h</sup>		ic				
43 56	$\tau$	dependent on chemical state						
5.9 <sup>h</sup>		K.T. Bainbridge, M. Goldhaber, E. Wilson, Phys. Rev. 90, 430 (1953).						
Rh	Neutron resonance (ev)		cryst s					
		1.260±0.004	$\sigma_0 = 5000 \pm 200$					
			$\Gamma = 0.158 \pm 0.005$					
		V.L. Sailor, Phys. Rev. 91, 53; 90, 363A (1953).						
Rh <sup>104</sup>	$\gamma$	14 <sup>+</sup> 0.0511 K/L > 5	$sm ce^-$					
45 59		170 <sup>+</sup> 0.0772 K/L ~ 0.6	scin					
4.3 <sup>m</sup>		(0.0511 $\gamma$ ) (X) XX	Rh(pile n)					
		†Relative intensity $ce^-$						
		W.C. Jordan, J.M. Cork, S.B. Burson, Phys. Rev. 90, 862 (1953).						
45 Rh <sup>104</sup>	$\gamma$	104 <sup>+</sup>	2	0.55			Rh(pile n); scin	
		44 <sup>+</sup>	w ~ 1.2					
		NO (0.55 $\gamma$ ) (X) NO (0.55 $\gamma$ ) (X)						
		W.C. Jordan, J.M. Cork, S.B. Burson, Phys. Rev. 90, 862 (1953).						
Pd <sup>109</sup>	$T_2$	13.6 <sup>h</sup>					Pd(pile n); chem	
46 63		Counted for 15 half-lives					G-M counter	
13 <sup>h</sup>								
		W.W. Weinke, Phys. Rev. 90, 410 (1953).						
Pd <sup>112</sup>	$\gamma$	0.018		U(28-Mev d) scin				
46 66				chem				
		R.Nussbaum, R.H. Wapstra, A.H. Verster, N.F. Cerfontain, H. Cerfontain, Physica 19, 385 (1953).						
Ag <sup>106</sup>	$\beta^-$	(<1% of $\epsilon$ )					scin	
47 59		W.L. Biedel, F.J. Shore, H.N. Brown, R.A. Becker, Phys. Rev. 90, 88 (1953).						
8.6 <sup>d</sup>								
24.5 <sup>m</sup>	$T_2$	24.0 <sup>m</sup>					Ag(22-Mev)	
	$\beta^-$	17% 1.45					sm 2	
		83% 1.96						
	$\beta^-$ (?)	<1% 0.36						
	$\gamma$	17% 0.512 $\alpha_K \sim 3 \times 10^{-3}$		scin, ce-				
		$\epsilon_K / (0.512) + annhil \gamma$ 's = 0.28						
		High energy photons probably bremsstrahlung						
		W.L. Biedel, F.J. Shore, H.N. Brown, R.A. Becker, Phys. Rev. 90, 888 (1953).						
Ag <sup>109</sup>	$\gamma$	(0.087) $\alpha_K \sim 0$	d 18 <sup>h</sup> Pd	scin				
47 62								
39 <sup>h</sup>								
		R.Nussbaum, R.H. Wapstra, A.H. Verster, N.F. Cerfontain, H. Cerfontain, Physica 19, 385 (1953).						
Ag <sup>112</sup>	$\beta^-$	15% ~1					U(28-Mev d) a	
47 65		20% 2.7					chem	$\alpha \beta \gamma$
		40% 3.5						
		25% 4.1						
	$\gamma$	0.62					scin	
		NO (4.1 $\beta$ ) (Y)						
		R.Nussbaum, R.H. Wapstra, A.H. Verster, N.F. Cerfontain, H. Cerfontain, Physica 19, 385 (1953).						
Cd	Neutron resonance (ev)							
		0.180 $\sigma_0 = 7800$						
		$\Gamma = 0.113$						
		B.N. Brockhouse, Can. J. Phys. 31, 432 (1953).						
	Neutron resonances (ev)							
		$E_n = 1$ to 4000 ev						
		18.0						
	st	27.2	Cd <sup>111</sup>	$\sigma_0 \Gamma^2 = 36$				
		66.6	Cd <sup>112</sup>					
	st	88.2	Cd <sup>110</sup>					
		122	Cd <sup>116</sup>					
		163						
		234						
		400						
		540						
		R.R. Palmer, L.M. Bollinger, Phys. Rev. 91, 450A (1953); verbal report.						



55	Cs <sup>134</sup>	$\gamma$	K/L	K/L
2+3	$\gamma$	0.202*	0.797	7.3
		0.475	~5	0.803*
		0.563	~10	1.039
		0.570*		1.168
		0.605	6.4	1.368
		0.663*		s ce <sup>-</sup> , pe <sup>-</sup>

\* ce<sup>-</sup> only observed

J. M. Cork, J. M. LeBlanc, W. H. Nester, M. K. Brice, Phys. Rev. 89, 907A; 90, 444 (1953).

56	Ba <sup>128</sup>	$\tau$	2.4 <sup>d</sup>	Cs(240-Mev p)
72		$\epsilon$	100%	p 3.5 <sup>m</sup> Cs chem

See Cs<sup>128</sup> for possible  $\gamma$ 's

R. W. Fink, E. O. Wilig, Phys. Rev. 91, 194 (1953).

56	Ba <sup>129</sup>	$\beta^+$	1.6	Ca(60-Mev p) s chem
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R. W. Fink, E. O. Wilig, Phys. Rev. 91, 194 (1953).

56	Ba <sup>131</sup>	$\tau$	11.8 <sup>d</sup>	Ba <sup>130</sup> (pile n)
75	$\gamma$	K/L		K/L
		0.055	≤1	0.249
		0.079	10	0.374
		0.092		0.489
		0.124	3.6	0.498
		0.133	5.8	0.585
		0.216	9	0.620
		0.239	≥8	s ce <sup>-</sup> , pe <sup>-</sup>

No 0.82 or 1.2  $\gamma$  scin

J. M. Cork, J. M. LeBlanc, W. H. Nester, M. K. Brice, Phys. Rev. 91, 76; 91, 497A (1953).

$\gamma$	w	~0.10	Ba(pile n)
55†		0.122	chem scin
45†		~0.220	
25†		0.370	
100†		0.500	
6†		0.620	
3†		0.90*	
3†		1.02*	
x	145†	K x ray	
(0.12Y) (0.50Y)			*Possible impurities

W. Payne, W. Goodrich, Phys. Rev. 91, 497A (1953); verbal report.

56	Ba <sup>133</sup>	$\gamma$	0.276	Ba(pile n)
77				J. M. Cork, J. M. LeBlanc, W. H. Nester, M. K. Brice, Phys. Rev. 91, 76 (1953).

56	Ba <sup>135</sup>	$\gamma$	0.268	Ba(pile n)
29 <sup>h</sup>				J. M. Cork, J. M. LeBlanc, W. H. Nester, M. K. Brice, Phys. Rev. 91, 76 (1953).

La	No neutron resonances	$E_n = 0.1$ to 30 ev
		V. L. Sailor, H. H. Landon, H. L. Foote, Phys. Rev. 91 450A (1953).

57	La <sup>142</sup>	$\beta^-$	>2.5	U(n,f) chem; a
		90†	0.63	scin
		10†	0.87	

(<0.5 $\beta$ ) ( $\gamma$ ):

A. V. Bosch, Physica 19, 374 (1953).

Gd	6.26	22.2*	355
	7.74	29.8	740
	11.6	33.2	
$E_0 = 2.58$	$\sigma_0 = 1600$	$\Gamma = 0.07$ ev	

\* Most prominent

R.R.Palmer, L.M.Bollinger, Phys. Rev. 91, 450A (1953); verbal report.

Gd <sup>150</sup>	$\tau_a$	$>10^5$	ic cc
64 86		No $\alpha$ daughter from $13.7^h$ Eu found	

R.C.Mack, J.J.Neuer, M.L.Pool, Phys. Rev. 91, 903 (1953).

Tb <sup>157</sup>	$\tau$	$>100^y$ or $<30^m$	
65 92		Not observed from Tb(24-Mev p) or asd of $8.2^h$ Dy	

T.H.Handley, E.L.Olson, Phys. Rev. 90, 500 (1953).

Dy	Neutron resonances (ev)	$E_n = 0.1$ to 30 ev
	1.72	5.47
	2.72	7.8
	3.7	10.6
	4.3	13.5
		16.8
		19.5
		29.5
		38.5

V.L.Sallor, H.H.Landon, H.L.Foote, Jr., Phys. Rev. 91, 450A (1953); verbal report.

Dy <sup>157</sup>	$\tau$	$8.2^h$	Tb(19-Mev p)
66 91	$\gamma$	0.325	ion chem, rel $\sigma$
		No $\beta^+$ or $e^-$ observed	scin

T.H.Handley, E.L.Olson, Phys. Rev. 90, 500 (1953).

Dy <sup>165</sup>	$\gamma$	0.1080	Dy(pile n)
66 99		K : L : L <sub>II</sub> : L <sub>III</sub> : M : N	
1.3 <sup>m</sup>		3 : 10 : 10 : 5 : 1.5	
		0.155?	scin, $\pi\pi$ ce <sup>-</sup>
		0.361	
		0.515	

(~ 1.5) (0.36 $\gamma$ , 0.52 $\gamma$ ) No (0.36 $\gamma$ ) (0.52 $\gamma$ )

W.C.Jordan, J.M.Cork, S.B.Burson, Phys. Rev. 91, 497A (1953); verbal report.

2.4 <sup>h</sup>	$\gamma$	0.0944	Dy(pile n)
		K : L : M	
		60 : 7.8 : 1.5	
		0.279	K/L > 5 $\pi\pi$ ce <sup>-</sup>
		0.361	K/L > 5
		0.634	
		0.71	
		1.02	

(~ 0.36) (0.28 $\gamma$ , 0.36 $\gamma$ , 0.63 $\gamma$ )

(~ 1.36) (0.094 $\gamma$ )

(0.28) (0.71 $\gamma$ ) (0.36 $\gamma$ ) (0.63 $\gamma$ ) No other  $\gamma\gamma$

W.C.Jordan, J.M.Cork, S.B.Burson, Phys. Rev. 91, 497A (1953).

Hf	Relative abundances	HfF <sub>4</sub> ; ms
	174	178
%	0.199	5.23
		18.55
A	178	179
%	27.23	13.73
		35.07

J.H.Reynolds, Phys. Rev. 90, 1047 (1953).

Ta <sup>182</sup>	$\gamma$	0.22	0.29	1.23	sl pe <sup>-</sup>
73 109		0.25	0.31	1.24	
117 <sup>d</sup>		0.27	1.01		
		0.28	1.13		

R.M.Pearce, K.C.Mann, Can. J. Phys. 31, 592 (1953).

W <sup>185</sup>	NO 0.134 $\gamma$	W(pile n)
74 111	scin, $\pi\pi$ ce <sup>-</sup>	

N.Lazar, R.J.D.Moffat, L.M.Langer, Phys. Rev. 91, 498A (1953).

Re <sup>186</sup>	$\beta^-$	0.08% (~0.3)
75 111		J.E.Robinson, C.E.Whittle, P.S.Jastram, Phys. Rev. 91, 498A (1953).

(0.93 $\beta$ ) (0.14 $\gamma$ ) ( $\theta$ ) b < 0.0007

C.E.Whittle, J.P.Hurley, P.S.Jastram, Phys. Rev. 91, 498A (1953); verbal report.

Au <sup>197</sup>	$\gamma$	d 23 <sup>h</sup> Hg $\pi\pi$ ce <sup>-</sup> ; scin
79 118	IT	0.130 K : L : L <sub>II</sub> : L <sub>III</sub> : M $\alpha_K \leq 2$
7.4 <sup>s</sup>		10 : <2 : >54 : 21 : 36 E3
		0.279 K : L $\alpha_K \sim 0.27$
		>60 : 10 M1

0.191 $\gamma$ , 0.077 $\gamma$ , previously assigned to decay of 23<sup>h</sup> Hg through 7.4<sup>s</sup> Au, now assigned to 65<sup>h</sup> Hg decay. New assignment based on above E3 0.130  $\gamma$ , now resolved from 0.134 $\gamma$ , and on new threshold for Au(n,n')7.4<sup>s</sup> Au of < 0.42.

J.W.Mihelich, A.de-Shalit, Phys. Rev. 91, 78 (1953); \* H.C.Martin, ibid.

Au <sup>198</sup>	$\gamma$	(0.68) (E) 2 80% (M) 1 40%
79 119	(0.68 $\gamma$ ) (0.41 $\gamma$ )	I = 2, 2, 0 $\gamma\gamma(\theta)$

D.Schiff, F.R.Metzger, Phys. Rev. 90, 849 (1953).

Hg	Neutron resonances (ev)	$E_n = 0.7$ to 1500 ev
	23.1*	91 311*
	33.3*	127 437
	42.8	175* 1230
	71	204

\* Most prominent

R.R.Palmer, L.M.Bollinger, Phys. Rev. 91, 450A (1953).

Hg <sup>197</sup>	$\gamma$	Au <sup>197</sup> (p,n) $\pi\pi$ ce <sup>-</sup>
80 117	23 <sup>h</sup>	L <sub>1</sub> : L <sub>II</sub> : L <sub>III</sub>
		0.134 0.4 : 11 : 10 E2
		0.165 10 : <1 : 15 M4
	65 <sup>h</sup>	0.0774* 100 : 45 : 34 M1+E2
		0.191* K/L=6

\* Previously assigned to 7.4<sup>s</sup> Au, q.v.

J.W.Mihelich, A.de-Shalit, Phys. Rev. 91, 78 (1953).

Tl <sup>203</sup>	$\mu(Tl^{203})/\mu(Tl^{205})$	= 0.990258 I
81 122		$\pm 0.000001$

Resonance frequencies depend on anions in solution; shifts same for Tl<sup>203</sup>, Tl<sup>205</sup>

M.S.Gutowsky, B.R.Garvey, Phys. Rev. 91, 81 (1953).

Tl <sup>208</sup>	NO 5.1 $\beta$ (<0.2%)		
81 127	P.E. Cavanagh, quoted by P. Marin, G.R. Bishop, H. Halban, Proc. Phys. Soc. 66A, 608 (1953).		
Pb <sup>207</sup>	$\tau$ 0.9 <sup>s</sup>	d 50 <sup>y</sup> Bi chem	
82 125	G. Friedlander, E. Wilson, A. Ghiorso, I. Perlman, Phys. Rev. 91, 498A (1953).		
82 126	0.8 <sup>s</sup>		
Pb <sup>212</sup>	$\tau$ 10.64 <sup>h</sup> $\pm$ 0.03		
82 130	Measured for 3 half-lives with ic		
	P. Marin, G.E. Bishop, H. Halban, Proc. Phys. Soc. 66A, 608 (1953).		
Pb <sup>214</sup>	$\gamma$	0.292	sl pe <sup>-</sup>
82 132		0.350	
	R.M. Pearce, K.C. Mann, Can. J. Phys. 31, 592 (1953).		
Bi <sup>212</sup>	$\alpha$ 35.4%		ic
83 129	$\beta^-$ 64.6%		
	P. Marin, G.R. Bishop, H. Halban, Proc. Phys. Soc. 66A, 608 (1953).		
Bi <sup>214</sup>	$\gamma$	0.452 0.932 1.750	
83 131		0.500 1.123 1.800	
	0.607 1.236 2.192		
	0.783 1.400		
	0.860 1.525	sl pe <sup>-</sup>	
	R.M. Pearce, K.C. Mann, Can. J. Phys. 31, 592 (1953).		
Po <sup>211</sup>	Not parent 0.8 <sup>s</sup> Pb (< 0.003%)		chem
84 127	G. Friedlander, E. Wilson, A. Ghiorso, I. Perlman, Phys. Rev. 91, 498A (1953).		
Po <sup>218</sup>	$\beta^-$ 0.022%		ic
84 134	F. Hessberger, B. Karlik, Sitzber. Akad. Wiss. Wien, Math-naturw. Kl. Abt. II a 161, 51 (1952).		
Ra <sup>223</sup>	$\tau$ 11.1 <sup>d</sup>	Rn <sup>222</sup> (pile n. 245)	
88 135	chem		
	A.P. Baerg, Phys. Rev. 90, 1121 (1953).		
Ac <sup>228</sup>	$\beta^-$ 13% 0.45	d Ra <sup>228</sup> $\sigma$ $\beta$ $\gamma$	
89 139	8% 0.64	chem	
	53% 1.11		
	7% 1.70		$\sigma$ $\gamma$
	9% 1.85		
	10% 2.18		
	0.0567		
	0.078		
	0.0978 0.232 0.965		
	0.1113 0.336 1.035		
	0.1275 0.410 1.095		
	0.179 0.458 1.587		
	0.184 0.907 1.640		
	(0.45 $\beta$ , 0.64 $\beta$ ) (>1.1 $\gamma$ ) (1.11 $\beta$ ) ( $\gamma$ )		
	(1.70 $\beta$ , 1.85 $\beta$ ) (>0.9 $\gamma$ ) No (2.18 $\beta$ ) ( $\gamma$ )		
	(0.098 ce <sub>L</sub> <sup>-</sup> , 0.127 ce <sub>L</sub> <sup>-</sup> , 0.184 ce <sub>L</sub> <sup>-</sup> ) ( $\gamma$ )		
	No (0.127 ce <sup>-</sup> ) (0.184 ce <sup>-</sup> ) No (>0.9 $\gamma$ ) (>0.9 $\gamma$ )		
	(~0.45 $\gamma$ ) (~1.0 $\gamma$ ) (~0.9 $\gamma$ ) (<0.4 $\gamma$ )		
	No (~0.45 $\gamma$ ) (>1.1 $\gamma$ )		

$^{89}\text{Ac}^{228}_{139}$	NO $\beta$ (soft $e^-$ ) delay observed; implies $500\mu\text{s} > \tau(0.057\gamma) > 0.1\mu\text{s}$ or $> 0.01\mu\text{s}$	
	J.Kyles, C.G. Campbell, W.J. Henderson, Proc. Phys. Soc. 66A, 519 (1953).	
Th <sup>228</sup>	$\gamma$ 100 <sup>f</sup> (0.083)	Th <sup>228</sup> extracted
90 138	14 <sup>f</sup> 0.133	from Ra <sup>228</sup>
	10 <sup>f</sup> 0.172	
	17 <sup>f</sup> 0.216	scin
	Decay products continuously removed	
	G.Boussières, P.Falk-Vairant, M.Riou, J.Tellier, C.Victor, Compt. rend. 236, 1874 (1953).	
Th <sup>230</sup>	$\gamma$ 33 <sup>f</sup> (0.087)	9% Th <sup>230</sup> scin
90 140	4 <sup>f</sup> 0.150	
	~0.3 <sup>f</sup> 0.207	
	1 <sup>f</sup> 0.254	
	$\pi$ 680 <sup>f</sup> L x ray	
	+Photons per $10^4$ disintegrations	
	G.Boussières, P.Falk-Vairant, M.Riou, J.Tellier, C.Victor, Compt. rend. 236, 1874 (1953).	
$\alpha$	~0.03% 4.44	~100% Th <sup>230</sup> ms
	~0.12% 4.47	ic
	(25%) (4.612)	
	(75%) (4.682)	
	(4.47 $\alpha$ ) (ce <sup>-</sup> ) (4.61 $\alpha$ ) (ce <sup>-</sup> )	
	No (4.44 $\alpha$ ) (ce <sup>-</sup> ) No (4.68 $\alpha$ ) (ce <sup>-</sup> )	
	G.Valladas, R.Bernas, Compt. rend. 236, 2230 (1953).	
Th <sup>234</sup>	$\beta^-$ 33% 0.103	Th <sup>234</sup> + Pa <sup>234</sup> source
90 144	67% 0.193	$\sigma$ $\pi$
	0.0294	$\sigma$ $\pi$ ce <sup>-</sup>
	0.0431	
	0.0471?	
	0.0630	
	0.0914 L <sub>1</sub> :M <sub>1</sub> :N <sub>1</sub> = 83:21:5.7	
	0.1002	
	[ce <sub>L</sub> <sup>-</sup> (0.091 $\gamma$ )] / $\beta$ = 0.083	
	$\gamma$ 's could belong to Pa <sup>234</sup>	
	P.H. Stoker, M. Heerschap, O.P. Hek, Physica 19, 433 (1953).	
Pa <sup>231</sup>	$\gamma$ (0.027)	$\tau = 4.2 \times 10^{-8}$ $\alpha$ $\gamma$
91 140		$\alpha_L \sim 7$ Ei a
	J.Tellier, M. Riou, P. Desniges, Compt. rend. 237, 41 (1953).	
Pa <sup>234</sup>	$\beta^-$ 1% 0.580	Th <sup>234</sup> +Pa <sup>234</sup> source
91 143	9% 1.500	$\sigma$ $\pi$
1.14 <sup>m</sup>	90% 2.305	
	0.229 converted in Pa	
	0.316	
	0.810 $\alpha_K \sim 0.06$ K/L = 5.2	
	0.845	
	0.877	
	No 0.395 $\gamma$ (ce <sub>L</sub> <sup>-</sup> / $\beta$ $< 3 \times 10^{-4}$ )	
	See Th <sup>234</sup> for possible $\gamma$ 's	
	P.H. Stoker, M. Heerschap, O.P. Hek, Physica 19, 433 (1953).	

## NEUTRON CROSS SECTIONS

## Neutron Cross Sections - Continued

Reaction	$\sigma$ Type	Value	Energy	Ref.
$H(n)$	$\sigma_a$	$0.332 \pm 0.007$	th	53h8
	$\sigma_a$	$0.329 \pm 0.004$	th	53h7
	$\sigma_t$	4.23	1.001	53f4
	$\sigma_t$	$3.675 \pm 0.020$	1.811	53f6
	$\sigma_t$	0.034	400	53n2
$H^2(n,n)$	$\sigma_{el}$	table	0.135-0.914	53t4
	$d\sigma_{el}/d\Omega$	graphs	0.135-0.914	53t4
	$d\sigma_{el}/d\Omega$	graphs	0.2-2.6	53a2
$H^2(n)$	$\sigma_t$	graph	0.2-3.0	53a2
$Be(n)$	$\sigma_t$	0.232	400	53n2
$B(n)$	$\sigma_a$	753	th	53c10
		Extrapolated value. $E_n = 0.025$ to 0.00068 ev		
		Isotopic composition not given		
$C(n,n')$	$\sigma(\sim 5\text{-Mev } \gamma\text{'s})$	0.2	14	53b5
	$\sigma(\sim 5\text{-Mev } \gamma\text{'s})$	0.09	14	53b5
$C(n)$	$\sigma_t$	graph	0.05-1	53k8
	$\sigma_t$	graph	2.2-2.8	53d4
	$\sigma_t$	0.298	400	53n2
	$\sigma$ (spallation)	90		53k5
$C^{13}(n,\gamma)$	$\sigma(5700^{\circ}\text{C})$	$\leq 0.01$	th	53b11
$O(n,n')$	$\sigma(\sim 7\text{-Mev } \gamma\text{'s})$	0.14	14	53b5
$O(n)$	$\sigma_t$	1.68	14	53a1
	$\sigma_t$	0.379	400	53n2
$Na(n)$	$\sigma_t$	graph	2.3-2.8	53d4
$Al(n,n')$	$\sigma(\sim 2\text{-Mev } \gamma\text{'s})$	~2	14	53b5
	$\sigma(\sim 6\text{-Mev } \gamma\text{'s})$	~0.3	14	53b5
$Al(n)$	$\sigma_t$	1.86	14	53a1
	$\sigma_t$	0.588	400	53n2
$P(n)$	$\sigma_t$	graph	0.1-0.7	53d4
$S(n)$	$\sigma_t$	0.681	400	53n2
$Cl(n)$	$\sigma_t$	graph	0.1-0.7	53d4
	$\sigma_t$	graph	0.15-1	53k6
	$\sigma_t$	graph	2.2-2.8	53d4

Reaction	$\sigma$ Type	Value	Energy	Ref.
$Cl(n)$	$\sigma_t$	0.743	400	53n2
$Cl^{35}(n,\alpha)$	$\sigma(\alpha)$	graph	3-4	53s4
$A^{36}(n,\alpha)$	$\sigma(\alpha_0)*$	table	2.1-4.4	53t5
	$\sigma(\alpha_1)*$	table	2.1-4.4	53t5
	$* \alpha_0$ to g.s. $S^{33}$ ; $\alpha_1$ to 1.1-Mev level $S^{33}$			
$A(n)$	$\sigma_t$	graph	0.4-1.1	53g4
$Ca^{46}(n,\gamma)$	$\sigma(3.4^d\text{Sc})$	0.25	th	53c6
$Sc(n,n)$	$\sigma_s$ coh	18		53m7
$Sc(n)$	$\sigma_t$	24		53m7
$Ti(n)$	$\sigma_t$	graph	2.2-2.8	53d4
$Fe(n,n)$	$\sigma_s$ incoh	0.43		53g5
	$\sigma_s$ free	11.39		53g5
	$\sigma_{el}$	2.0	1.0	53w3
	$d\sigma_{el}/d\Omega$	graph	1.0	53w3
$Fe(n)$	$\sigma_t$	1.07	400	53n2
$Co^{59}(n,\gamma)$	$\sigma(10.7^m\text{Co})$	19	th	53m8
	$\sigma(10.7^m\text{Co})$	$\leq 0.008$	$\sim 0.025$	53k4
$Ni(n,n)$	$\sigma_s$ coh	12.9		53g5
	$\sigma_s$ free	17.43		53g5
	$\sigma_{el}$	2.8	1.0	53w3
	$d\sigma_{el}/d\Omega$	graph	1.0	53w3
$Cu(n,n)$	$\sigma_{el}$	2.9	1.0	53w3
	$d\sigma_{el}/d\Omega$	graph	1.0	53w3
$Cu(n)$	$\sigma_t$	1.19	400	53n2
$Cu^{63}(n,\gamma)$	$\sigma(12.9^h\text{Cu})$	0.12	$\sim 0.025$	53k4
$Zn(n)$	$\sigma_{el}$	3.3	1.0	53w3
	$d\sigma_{el}/d\Omega$	graph	1.0	53w3
$Ge^{74}(n,\gamma)$	$\sigma(82^m\text{Ge})$	0.038	$\sim 0.025$	53k4
$Br(n)$	$\sigma_t$	graph	2.2-2.8	53d4
$Rh(n)$	$\sigma_s$ free	5.5	1.26 ev	53s7
$Pd^{102}(n,\gamma)$	$\sigma(17^d\text{Pd})$	4.8	pile	53m5
$Ag(n,n)$	$\sigma_{el}$	4.2	1.0	53w3

## Neutron Cross Sections - Continued

Reaction	$\sigma$ Type	Value	Energy	Ref.	
Ag(n,n)	$d\sigma_{el}/d\Omega$	graph	1.0	53w3	53a2 R.K.Adair, A.Okazaki, M.Walt, Phys. Rev. 89, 1165, (1953).
Cd(n,n)	$\sigma_{el}$	5.2	1.0	53w3	53a4 H.Adler, P.Huber, W.Hälg, Helv. Phys. Acta 26, 349, (1953).
	$d\sigma_{el}/d\Omega$	graph	1.0	53w3	53b5 M.E.Battat, R.W.Davis, A.H.Frentrop, Phys. Rev. 91, 441A (1953); LA-1507(1953).
Cd(n)	$\sigma_t$	1.85	400	53n2	53b9 A.P.Baerg, Phys. Rev. 90, 1121 (1953).
In(n,n)	$\sigma_{el}$	6.1	1.0	53w3	53b11 E.Broda, G.Rohringer, Naturwiss. 40, 337 (1953).
	$d\sigma_{el}/d\Omega$	graph	1.0	53w3	53d4 H.R.Dvorak, R.N.Little, Jr., Phys. Rev. 90, 618 (1953).
Sn(n,n)	$\sigma_{el}$	6.0	1.0	53w3	53f4 R.E.Fields, R.K.Adair, R.L.Becker, S.E.Dardeen, Phys. Rev. 91, 441A (1953); Verbal report.
	$d\sigma_{el}/d\Omega$	graph	1.0	53w3	53f6 D.H.Frisch, MIT Progress Report May, 1953, 63. Supersedes 53s1 whose value of 3.68 was erroneously reported as 3.38.
NaI(n)	$\sigma_a$	7.4	th	53h7	53g4 J.B.Guernsey, C.Goodman, Phys. Rev. 91, 440A (1953); Verbal report.
Nd <sup>142</sup> (n)	$\sigma_a$	13	pile	53w4	53g5 M.D.Goldberg, J.A.Harvey, Phys. Rev. 91, 451A (1953); Verbal report.
Nd <sup>143</sup> (n)	$\sigma_a$	334	pile	53w4	53h7 B.Hamermesh, G.R.Ringo, S.Wexler, Phys. Rev. 90, 603, (1953). Based on B "standard" for which $\sigma_a = 755 \pm 3$ .
Nd <sup>144</sup> (n)	$\sigma_a$	$\sim 0$	pile	53w4	53h8 S.P.Harris, C.Q.Muehlhause, D.Rose, H.P.Schroeder, G.E.Thomas, Jr., S.Wexler, Phys. Rev. 91, 125 (1953). Based on B "standard" for which $\sigma_a = 755 \pm 3$ .
Nd <sup>145</sup> (n)	$\sigma_a$	37	pile	53w4	53k4 C.Kimball, B.Hamermesh, Phys. Rev. 89, 1306 (1953). Based on Seren's $\sigma_a$ 's for elements.
Nd <sup>146</sup> (n)	$\sigma_a$	$\sim 4$	pile	53w4	53k5 D.A.Kellogg, Phys. Rev. 90, 224 (1953).
Nd <sup>148</sup> (n)	$\sigma_a$	$\sim 4$	pile	53w4	53k6 R.M.Kiehn, C.Goodman, K.F.Hansen, Phys. Rev. 91, 66 (1953).
Nd <sup>150</sup> (n)	$\sigma_a$	$\sim 0$	pile	53w4	53m5 W.W.Meinke, Phys. Rev. 90, 410 (1953). Based on $\sigma_{(Pd-108)} = 11.7$ , Seren's value corrected for $T = 13.6^h$ .
Hf(n,n)	$\sigma_a$	4.7	1.0	53w3	53m7 W.O.Milligan, L.W.Vernon, H.A.Levy, S.W.Peterson, Jr., Phys. Chem. 57, 535 (1953).
	$d\sigma_{el}/d\Omega$	graph	1.0	53w3	53m8 N.Moss, L.Yaffe, Can. J. Phys. 31, 391 (1953). Based on $\sigma_a(Au) = 93$ .
Au(n)	$\sigma_a$	97.5	th	53c10	53n2 V.A.Nedzel, Phys. Rev. 91, 440A; 90, 169 (1953).
Extrapolated value assuming $1/V_0$ . $E_n = 0.0035$ to 0.00068 ev					
	$\sigma_t$	graph	0.1-0.7	53s4	53s4 S.C.Snowdon, W.D.Whitehead, Phys. Rev. 90, 615 (1953).
Pb(n,n)	$\sigma_{el}$	4.6	1.0	53w3	53s7 V.L.Sailor, Phys. Rev. 91, 53 (1953).
	$d\sigma_{el}/d\Omega$	graph	1.0	53w3	53t4 P.R.Tunncliffe, Phys. Rev. 89, 1247 (1953).
Pb(n)	$\sigma_t$	2.89	400	53n2	53t5 B.J.Toppel, S.D.Bloom, Phys. Rev. 91, 473A (1953).
Bi(n,n)	$\sigma_{el}$	4.8	1.0	53w3	53w3 M.Walt, H.H.Barshall, Phys. Rev. 90, 714; 91, 441A (1953).
	$d\sigma_{el}/d\Omega$	graph	1.0	53w3	53w4 W.H.Walker, H.G.Thode, Phys. Rev. 90, 447 (1953). Based on $\sigma_a(Nd) = 48$ .
Rn <sup>222</sup> (n)	$\sigma(11.2^d Ra^{223})$	0.7	pile	53b9	
Th(n)	$\sigma_t$	3.23	400	53n2	
U(n)	$\sigma_t$	3.26	400	53n2	

## GROUND STATE Q'S

Reaction	Standard	Value	Method	Ref.
$H^2(d,n)He^3$		$+3.25 \pm 0.06$	ppl	53d5
$H^3(d,n)He^4$		$+17.7 \pm 0.3$	ppl	53r3
$He^5 \rightarrow \alpha + n$		$+0.95 \pm 0.07$	range	53m6
$Li^6(d,t)Li^5$		$+0.9 \pm 0.1$	s	53f5
$Li^6(d,dp)He^4$		$+2.51 \pm 0.04$	s	53f5
$Li^6(d,\alpha)He^4$		$+22.375 \pm 0.014$	s	53p2
$Li^7(p,\alpha)He^4$		$+17.344 \pm 0.013$	s	53p2

## Ground State Q's - Continued

Reaction	Standard	Value	Method	Ref.
$\text{Li}^7(\text{p},\text{n})\text{Be}^7$	$\{\text{Na } \gamma$ $[\text{Mg}(\text{p},\text{p}')] \}$	$-1.6464 \pm 0.0009$	thresh	53j1
$\text{Li}^7(\text{d},\alpha)\text{He}^5$		$+14.2 \pm 0.1$	ppl	53c8
$\text{Be}^9(\text{n},\gamma)\text{Be}^{10}$	absolute	$+6.816 \pm 0.006$	pair s	53k7
$\text{B}^{10}(\text{d},\alpha)\text{Be}^8$		$+17.87 \pm 0.06$	s	53c9
$\text{B}^{11}(\text{d},\text{p})\text{B}^{12}$		$+1.140 \pm 0.008$	s	53e4
$\text{C}^{12}(\text{d},\text{p})\text{C}^{13}$		$+2.722 \pm 0.004$	s	53d2
$\text{C}^{13}(\text{d},\alpha)\text{B}^{11}$		$+5.166 \pm 0.005$	s	53d2
$\text{N}^{14}(\text{n},\gamma)\text{N}^{15}$	absolute	$+10.832 \pm 0.008$	pair s	53k7
$\text{O}^{16}(\text{d},\alpha)\text{N}^{14}$		$+3.119 \pm 0.005$	s	53p2
$\text{Mg}^{24}(\text{n},\gamma)\text{Mg}^{25}$	absolute	$+7.334 \pm 0.007$	pair s	53k8
$\text{Mg}^{26}(\text{n},\gamma)\text{Mg}^{27}$	absolute	$+6.440 \pm 0.008$	pair s	53k8
$\text{Al}^{27}(\text{n},\gamma)\text{Al}^{28}$	absolute	$+7.724 \pm 0.008$	pair s	53k7
$\text{Si}^{28}(\gamma,\text{n})\text{Si}^{27}$		$-16.9 \pm 0.2$	thresh	53s6
$\text{Si}^{28}(\text{n},\gamma)\text{Si}^{29}$	absolute	$+8.468 \pm 0.008$	pair s	53k7
$\text{Si}^{28}(\text{p},\text{n})\text{P}^{28}$	$\text{Mg}^{24}(\text{p},\text{n})$	$-15.1 \pm 0.5$	thresh	53g3
$\text{Si}^{29}(\text{n},\gamma)\text{Si}^{30}$	absolute	$+10.60 \pm 0.011$	pair s	53k7
$\text{S}^{32}(\text{p},\text{n})\text{Cl}^{32}$	$\text{Mg}^{24}(\text{p},\text{n})$	$-13.9 \pm 0.5$	thresh	53g3
$\text{Cl}^{35}(\text{n},\alpha)\text{P}^{32}$	$\text{Po}^{212}\alpha$	$+0.97 \pm 0.18$	ic	53a3
$\text{A}^{36}(\text{n},\alpha)\text{S}^{33}$		$+2.0 \pm 0.1$	pc	53t5
$\text{K}^{39}(\alpha,\text{p})\text{Ca}^{42}$		$-0.18$	range	53s5
$\text{K}^{41}(\alpha,\text{p})\text{Ca}^{44}$		$+1.20$	range	53s5
$\text{Ca}^{40}(\gamma,\text{n})\text{Ca}^{39}$		$-15.8 \pm 0.1$	thresh	53s6
$\text{Ca}^{40}(\text{d},\text{p})\text{Ca}^{41}$	$\text{O}^{16}(\text{d},\text{p})$	$+6.14 \pm 0.05$	ppl	53h9
$\text{Ca}^{48}(\text{p},\text{n})\text{Sc}^{48}$	$\{\text{F}^{19}(\text{p},\alpha)\}$ $\{\text{Li}^7(\text{p},\text{n})\}$	$>0.64$	thresh	53t6
$\text{Ti}^{49}(\text{p},\text{n})\text{V}^{49}$	$\{\text{F}^{19}(\text{p},\alpha)\}$ $\{\text{Li}^7(\text{p},\text{n})\}$	$-1.391 \pm 0.005$	thresh	53t8
$\text{V}^{51}(\text{n},\gamma)\text{V}^{52}$	$\{\text{Au},\text{Cs}$ $\text{Na } \gamma's\}$	$+7.4$	scin	53h8
$\text{Mn}^{55}(\text{p},\text{n})\text{Fe}^{55}$	$\{\text{F}^{19}(\text{p},\alpha)\}$ $\{\text{Li}^7(\text{p},\text{n})\}$	$-1.020 \pm 0.005$	thresh	53t6
$\text{Cu}^{63}(\gamma,\text{n})\text{Cu}^{62}$	Q value masses	$-10.61 \pm 0.05$	thresh	53b7

## Ground State Q's - Continued

Reaction	Standard	Value	Method	Ref.
$\text{Zn}^{64}(\text{p},\text{n})\text{Ga}^{64}$	$\{\text{Cu}^{63}(\text{p},\text{n})\}$ $\{\text{Zn}^{66}(\text{p},\text{n})\}$	$-8.0 \pm 0.5$	thresh	53c7
$\text{Zn}^{67}(\text{p},\text{n})\text{Ga}^{67}$	$\{\text{F}^{19}(\text{p},\alpha)\}$ $\{\text{Li}(\text{p},\text{n})\}$	$-1.785 \pm 0.005$	thresh	53t6
$\text{Zn}^{70}(\text{p},\text{n})\text{Ga}^{70}$	"	$-1.45 \pm 0.03$	thresh	53t6
$\text{Ga}^{71}(\text{p},\text{n})\text{Ge}^{71}$	"	$-1.03 \pm 0.03$	thresh	53t6
$\text{Ge}^{73}(\text{p},\text{n})\text{As}^{73}$	"	$-1.15 \pm 0.03$	thresh	53t6
$\text{As}^{75}(\text{p},\text{n})\text{Se}^{75}$	"	$-1.652 \pm 0.005$	thresh	53t6
$\text{Sr}^{88}(\text{d},\text{p})\text{Sr}^{89}$	$\text{O}^{16}(\text{d},\text{p})$	$+4.18 \pm 0.08$	ppl	53h9
$\text{Mo}^{100}(\gamma,\text{n})\text{Mo}^{99}$		$-8.1$	thresh	53d6
$\text{Ag}^{109}(\gamma,\text{n})\text{Ag}^{108}$	Q value masses	$-9.07 \pm 0.07$	thresh	53b7
$\text{Ag}^{109}(\alpha,2\text{n})\text{In}^{111}$		$-14.3 \pm 0.2$	thresh	53b12
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xxi plus 632 pages,  
69 illustrationsFor list of contents see:  
NSA 5, No. 22, p B

